APPENDIX H

Contamination and Salinity Assessment

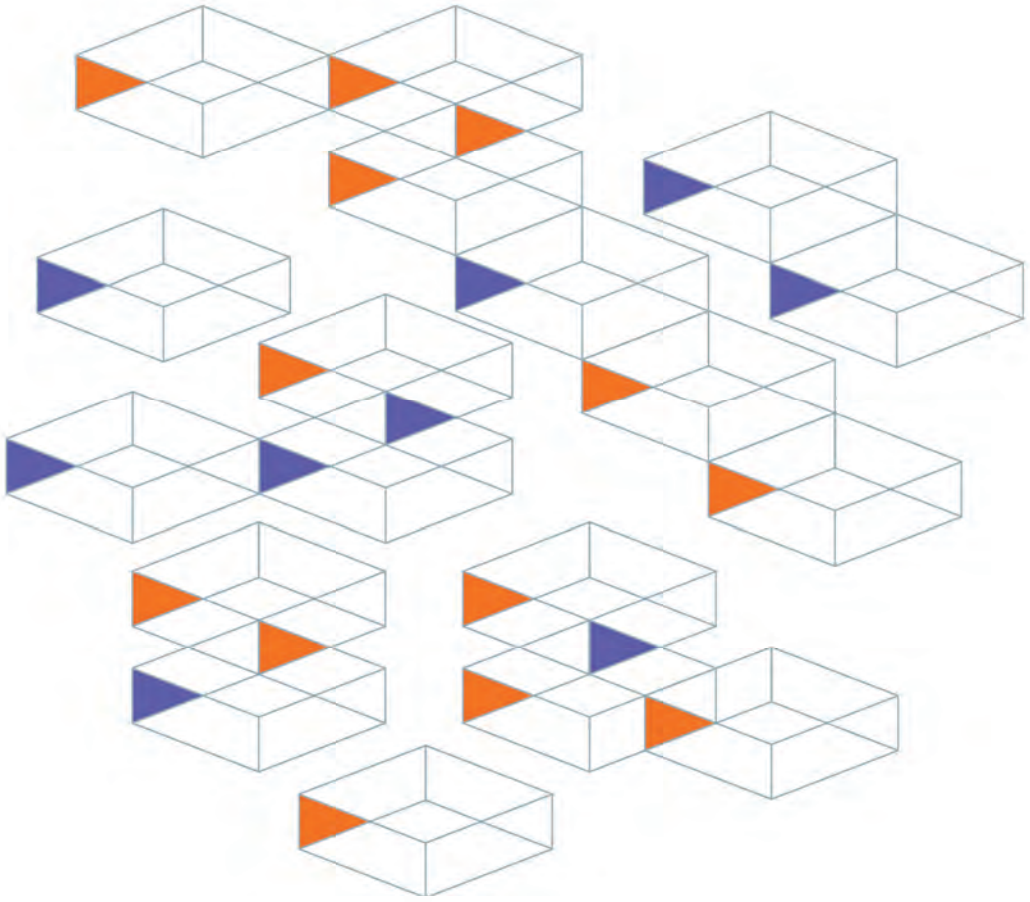
Site Plus

PHASE 1 CONTAMINATION ASSESSMENT AND SALINITY ASSESSMENT

PART LOT 24 DP1086823, 10 CRASE PLACE, GRASMERE, NSW

Report Date: 25 November 2013

Reference: ENAUWOLL04150AA-R01 (Rev. 1)



Boundaries
are set by those
who are afraid
to push them

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PART LOT 24 DP1086823, 10 CRASE PLACE, GRASMERE, NSW

Report Date: 25 November 2013

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LIST OF ATTACHMENTS

ABBREVIATIONS

AEC	Area of Environmental Concern
AHD	Australian Height Datum
bgs	below ground surface
BTEX	Benzene, Toluene, Ethylbenzene and Xylenes
COPC	Chemical of Potential Concern
DECC	Department of Environment and Climate Change (NSW)
DLWC	Department of Land and Water Conservation (NSW)
NEHF	National Environmental Health Forum
NEPM	National Environment Protection (Assessment of Site Contamination) Measure
NSW EPA	Environment Protection Authority of New South Wales
NSW SALIS	NSW Soil and Land Information System
OCP	Organochlorine Pesticide
OPP	Organophosphorus Pesticide
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
TRH	Total Recoverable Hydrocarbon
VOC	Volatile Organic Compound

EXECUTIVE SUMMARY

Coffey was commissioned by Site Plus to undertake a Phase 1 Contamination Assessment and Salinity Assessment at No. 10 Crase Place, Grasmere, NSW (herein referred to as the 'Site').

We understand that a submission is being prepared to amend current zoning allowing additional dwellings to occupy the site. Camden Council has requested information concerning soil contamination and salinity, as part of this submission. The building envelope is currently constrained by an odour buffer associated with Sydney Water's water treatment plant located northeast of the site. The building envelope occupies an approximate area of 2ha.

The objectives of the assessment were to:

- Assess, at a preliminary level, the potential for contamination to be present on the site from previous site activities with respect to its proposed land use and provide recommendations on the need for further stages of assessment; and
- Assess for potential salinity issues.

The scope of work developed to meet this objective included a review of site history information, review of geotechnical reports and salinity indicators, and site walkover. The results of the desk study and site walkover were interpreted and assessed with respect to these objectives.

Contamination Issues

Site history information indicates that the site has been used for grazing land since at least the 1900's. The site had formed part of a larger parcel of land (48.4ha) and has been progressively subdivided since 2005 into smaller lots. Apart from installation of minor infrastructure (i.e. cul-de-sac and stormwater drain), the site has remained undeveloped. There were some gaps in the early site history which cannot preclude certain activities occurring or structures having been present at the site.

Based on the available site history information, the likelihood of these contaminating activities occurring at the site was assessed as low to very low. Further stages of investigation are not considered necessary based on information presently available.

It is recommended that an unexpected finds procedure be developed to manage potential contamination, should it be encountered during construction. Potential contamination may include, but not limited to, oil staining, building materials such as fibre cement, burial pits, fill, odours or discolouration.

Salinity Issues

Based on literature review and topography, the site has been assessed to have a low to moderate salinity potential. A low salinity potential is expected in hill crest/sandstone areas and transitioning to a moderate potential in the lower lying regions near the western site boundary.

Salinity issues can be exacerbated through inappropriate development practices, which can mobilise salt to the surface where it can come into contact with structures. The risk to structures and style of mitigation measures are dependent on profiling and construction details of the proposed development. Management strategies are available to mitigate the effects of potential salinity and options can be further refined following additional investigations during detailed design. Further investigations can be undertaken at a future stage, for example, as part of a development application.

EXECUTIVE SUMMARY

This executive summary must be read in conjunction with the full report and in the context of the attached “Important Information about your Coffey Environmental Report” and to the statement of limitations in Section 9 of this report.

♦ ♦ ♦

1 INTRODUCTION

Coffey was commissioned by Site Plus to undertake a Phase 1 Contamination Assessment and Salinity Assessment at No. 10 Crase Place, Grasmere, NSW (herein referred to as the 'Site') (Figure 1). The work was completed in general accordance with our proposal ENAUWOLL04150AA-P01, dated 6 September 2013. This report presents the findings of the assessment.

We understand that a submission is being prepared to amend current zoning allowing additional dwellings to occupy the site. Camden Council (Council) has requested information concerning soil contamination and salinity, as part of this submission. The building envelope is currently constrained by an odour buffer associated with Sydney Water's water treatment plant located north east of the site. The buffer zone is shown on Figure 2. The building envelope occupies an approximate area of 2ha.

The objectives of the assessment were to:

- Assess, at a preliminary level, the potential for contamination to be present on the site from previous site activities with respect to its proposed land use and provide recommendations on the need for further stages of assessment; and
- Assess for potential salinity issues.

2 SCOPE OF WORKS

The work carried out by Coffey to meet the above objectives included:

- Review of published information (e.g. topographic, geological, soil landscape, salinity potential maps) and previous geotechnical reports.
- Specific information reviewed for assessing the likelihood of potential contamination to exist at the site included review of: historical title records, aerial photographs and Camden Council planning records; and search of NSW EPA and WorkCover Dangerous Goods licence databases.
- Specific information reviewed for assessing salinity potential included the collation of broad scale information including review of climate and rainfall data, land use and vegetation history, search of the NSW Office of Water groundwater database, NSW Soil and Landscape Information Systems and defining landforms.
- A site walkover to visually assess potential sources of contamination, observe surrounding land uses, topography, drainage, nearby sensitive environments, and assess details of the site history and desk study to further assess potential areas of environmental concern (AECs) and contaminants of potential concern (COPCs) and obvious evidence of saline impacted soils.
- Preparation of this report summarising results of the desk study and site walkover and making conclusions and recommendations with respect to the objectives outlined in Section 1.

3 SUMMARY OF SITE LAND USE AND SURROUNDING ENVIRONMENT

The Site identification information is summarised in Table 1. The Site locality, Site layout and general surrounding land uses are shown in Figures 1 and 2. The Site is defined on Figure 2. The Site forms part of a larger parcel of land which extends a further 265m north.

Table 1: Summary of Site Identification Information

Street Address	10 Crase Place, Grasmere, NSW
Site Area (approximate)	2ha
Dimensions (approximate)	165m (southern boundary) by 110m (eastern boundary)
Title Identifiers	Part Lot 24 DP1086823
Local Government Area	Camden
Parish and County	Camden
Current Zoning	R5 Large Lot Residential and RUI Primary Production under the Camden Council Local Environmental Plan (LEP) 2010.
Grid Co-ordinates	285317E; 6228585N (from the southeastern corner of the Site)
Surrounding Land Uses	North: Grazing land then Werombi Road and Sydney Water Sewerage Treatment Plant East: Grazing land and a residential dwelling South: Two residential dwellings and vacant land West: Dams and connecting watercourses

3.1 Topography and Drainage

Reference to the Camden 1:25,000 topographic map published by the New South Wales Department of Information, Technology and Management indicates that the Site is at an elevation between 80m and 100m above Australian Height Datum (AHD) (Refer to Figure 1). This is consistent with survey plans included in the Local Environmental Study (Coffey, 1999).

The site is located on the western slopes of a local rise in topography and has a moderate downward slope of 5° to 10° in that direction. Surface water that is not absorbed into the ground is likely to follow the topography, flowing west, into a series of dams and connecting watercourses adjacent to the site's western boundary. Water released from these dams will flow north through a culvert beneath Werombi Road and discharging into a larger dam located approximately 580m north of the site. The topography map and aerial photographs suggest that this dam does not routinely discharge into the Napean River located 75m north of this dam.

3.2 Soil Landscape

The Wollongong to Port Hacking 1:100,000 soil landscape series sheet 9029-9129, (Soil Conservation Service of NSW, 1990) shows that the Site is situated within the Blacktown soil landscape. Blacktown is a residual soil landscape characterised by gently undulating rises on Wianamatta Group shale with broad rounded crests and ridges of gently inclined slopes. The soils on crests and upper slopes are well drained however lower slopes are subject to poor drainage and drainage depressions. Soils are moderately reactive, highly plastic and have low fertility.

3.3 Local Geology

The 1:100,000 Wollongong-Port Hacking Geological Map 9029-9129 (Geological Survey of NSW 1985) shows that the Site is underlain by the Bringelly Shale. The Bringelly Shale is described as shale, carbonaceous claystone, laminite with coal in parts which forms part of the Wianamatta Group of Rocks. The map indicated that a geological contact with an 'unnamed sandstone member' was located near the southern part of the site. This unnamed sandstone member was described as fine to medium grained quartz-lithic sandstone.

This description is generally consistent with subsurface conditions encountered during previous investigations undertaken at the site (Refer to Section 4) and observations made of road cuttings near the site (Refer to Section 4).

3.4 Local Hydrogeology and Groundwater Use

A survey of groundwater bores within a 1 kilometre radius of the site registered with NSW Office of Water indicated that there are 10 registered bores. The bores were located between 400m and 1km from the site and were either up-gradient or cross gradient of the site. Three of the ten bores were registered with work summary sheets. These three bores were installed between 1965 and 2003 and registered for stock and / or irrigation purposes. Salinity information was listed for bores GW023588 and GW105251. Groundwater from bore GW023588 was described as 'very salty' whereas the salinity was measured at GW105251 but units were not specified. Water bearing zones were encountered in the 'clay shale' at 3m and 5.5m, and depths greater than 8.5m within shale and sandstone units.

No other chemical data was listed on the work summary sheets. The work summary sheets for groundwater bores GW023588, GW072309 and GW105251 and their location are presented in Appendix A.

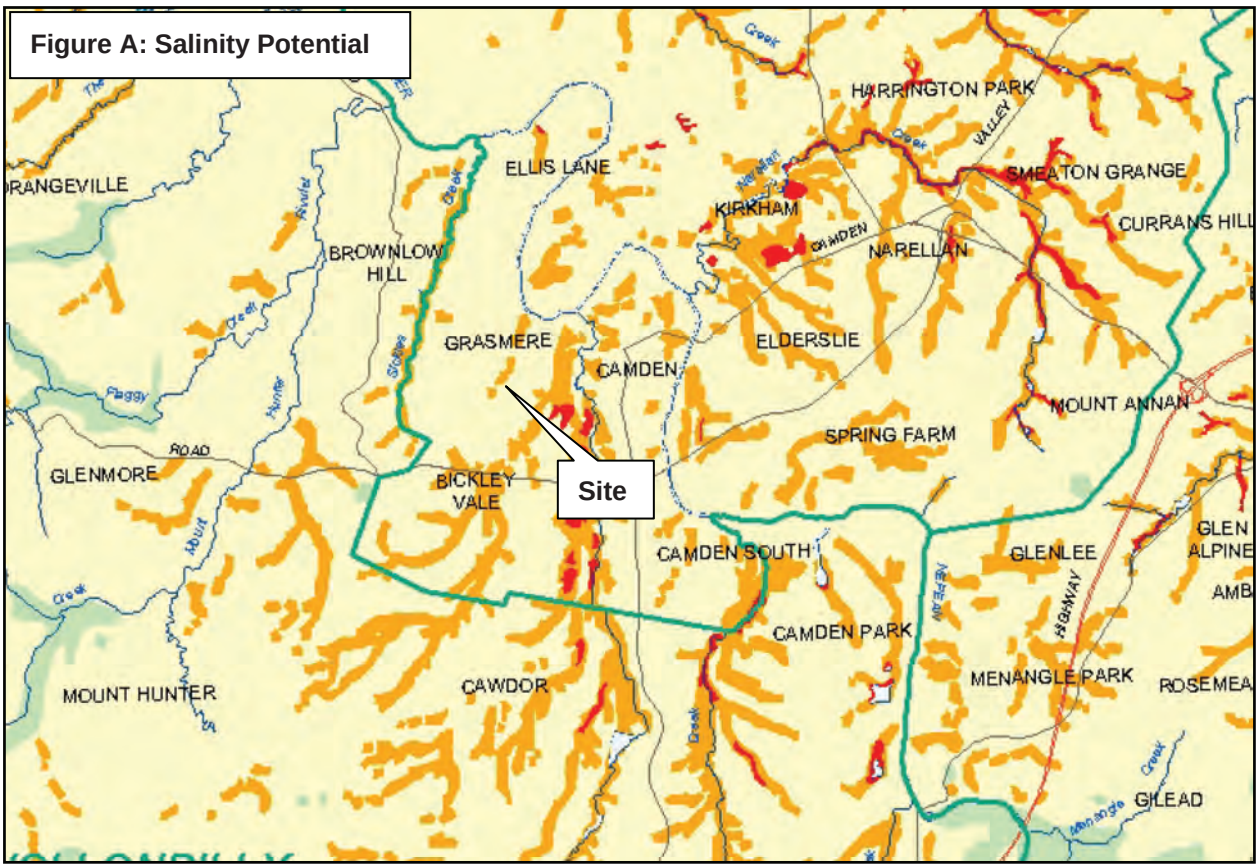
Based on site observations and results of the desk study, groundwater is expected to follow local topography, flowing in a westerly direction towards the dams and connecting watercourses. Depth to groundwater across the site is expected to be variable. In areas of higher elevation, groundwater may be encountered at depths between 3m and 5m; however in lower regions near the foot slopes, groundwater could be less than 1m from the ground surface and in periods of heavy rain groundwater seepages may be observed.

3.5 Salinity Potential

The Salinity Potential in Western Sydney 2002 (NSW DIPNR, 2003) map indicates the site located within an area of moderate salinity potential where saline areas may occur in this zone, which have not yet been identified or may occur if risk factors change adversely (Refer to Figure A). This zone is characterised by hill slopes and crests on Wianamatta Group Shales and situated within particular soil landscapes including the Blacktown Soil Landscape. Other salinity indicators such as scalding and certain vegetation types were also associated with this zone.

A high salinity potential was mapped in an area adjacent to the site's western boundary and appears to be associated with the three dams and connecting watercourses (Refer to Figure A). The map indicates these areas are predisposed to salinity based on soil, geology, groundwater and topography. This area is also located at the lower slopes of a local rise and forms part of a drainage system where water accumulation is high.

Figure A: Salinity Potential



Salinity Potential

Very Low	Moderate	High	Known Salinity

The NSW Soil and Land Information System (SALIS) database was reviewed and identified three soil technical reports prepared for properties located between 600m to 1.1km from the site. A copy of these reports and map showing where the soil survey was done is presented in Appendix A.

Profiles 58 and 59 represent hillcrest or hill slope similar to that of the site, whereas Profile 84 is located in along a plain. Electrical conductivity concentrations reported in soils from profiles 58 and 59 were notably lower than those at profile 84. This was consistent with field observations where salting was evident at Profile 84. Profiles 58 and 59 reports “no salting evident”, however Profile 59 did note “might be salty”. This observation for Profile 59 does not appear to be reflected in electrical conductivity results that suggest the potential for salt is low. Based on the descriptions provided, Profiles 58 and 59 are comparable with the landform for the site. Therefore, salinity conditions at the site could be similar to those encountered at Profiles 58 and 59.

3.6 Climate Information

Rainfall and other climate statistics for the Site were recorded by the Bureau of Meteorology at Camden Airport (Station No. 68192), which is located approximately 2.7km north of the Site (Refer to map in Appendix B).

These statistics are based on data recorded by the Camden Airport weather station since 1943 and are presented in Appendix B. Table 2 provides a summary of annual mean for temperature, rainfall and wind. No information was available on evaporation.

Table 2: Annual Mean for Climate Data

Climate Data	Rainfall (mm)	Temperature (°C)		Wind (km/h)	
		Minimum	Maximum	9am conditions	3pm conditions
Mean	768.4	10.2	23.6	7.0	15.9

Climate information can be incorporated into future salinity assessments once building designs are finalised.

4 SUMMARY OF PREVIOUS INVESTIGATIONS

Coffey was commissioned by Planning Workshop Australia in 1999 to undertake a land capability assessment incorporating items of landform, geotechnical, mineral resources, soils and agricultural capability of a 48.4ha study area, which included the current site. As part of the 1999 study, Coffey reviewed a report prepared by Regional GTS Pty Ltd presenting results of a geotechnical investigation undertaken in 1995. The references for these reports are listed below:

- Regional GTS Pty Ltd (1995) Geotechnical Assessment for proposed residential development, Lots 100, 102 and Part 1 Old Oakes Road, Camden (Report Ref: 95225/GK/1, dated 8 August 1995).
- Coffey Geosciences Pty Ltd (1999) Grasmere Local Environmental Study – Land Capability Study, southwest corner of Werombi Road and Old Oaks Road, Grasmere (Report Ref: S20166/1-AG, dated 28 July 1999).

A geotechnical report held on Council file was briefly reviewed (Geotechnique, 2005). The reference for this report is listed below:

- Geotechnique Pty Ltd (2005) Site Classification for Proposed Subdivision, cnr Werombi and Old Oakes Roads, Grasmere (Report Ref: 10255/2-AA, dated 4 July 2005).

The relevant parts of these reports are summarised in the following sections.

4.1 Geotechnical Assessment (Regional GTS, 1995)

Regional GTS (GTS) was commissioned by T.J. O'Donnell & Associates Pty Ltd to undertake a geotechnical assessment of a 43.6ha property, including the current Site. The purpose of the assessment was to assess the suitability of the land for proposed residential development. This included site stability, site classification (in accordance with AS2870.1 & .2, 1990) and other geotechnical restraints.

To achieve this objective, published geological information was reviewed, site observations of surface features such as rock outcrops and vegetation were made and collecting information on subsurface conditions from seven hand auger boreholes drilled to a maximum depth of 1.2m.

The Site and surrounding properties were mostly covered with a thick grass that had been recently slashed and trees were sparsely located throughout the area. Residential dwellings were noted west and south of the Site, but none were observed on the Site. Dams and connecting watercourses were present at the time of the assessment. The report notes that water releases from these dams flow north towards a culvert beneath Werombi Road. This culvert is located approximately 150m west of the Werombi Road and Old Oaks Road intersection.

The subsurface conditions encountered at the borehole locations were topsoil overlying residual clay soils then extremely to highly weathered shale. No fill or groundwater was observed at the borehole locations. The subsurface conditions are summarised in Table 3.

Table 3: Summary of Subsurface Conditions

Unit	Description	Unit Thickness
Topsoil	Clayey silt, low plasticity, highly organic, dry to moist, firm.	0.2m to 0.3m
Residual	Silty Clay, medium to high plasticity, red-brown becoming orange-grey with depth, moist, stiff.	0.8m to >1m
Extremely to highly Weathered Shale	Shale, grey. Extremely weathered shale (described as a soil) was dry to moist and very stiff to hard.	Unknown

The soil observed at the dams and connecting water courses was inferred to be alluvial, comprising silts but was not assessed directly. The closest borehole to the current site was located approximately 100m north of the site's northern boundary and was the only borehole to encounter highly weathered shale. Highly weathered shale was also observed in road cuttings near the Sewerage Treatment Plant, a further 170m north of this borehole. The assessment inferred the shales to be those consistent with the Bringelly Shale Member of the Wianamatta Group of rocks.

4.2 Land Capability Study (Coffey, 1999)

A land capability assessment was undertaken by Coffey in 1999 for inclusion in a Local Environmental Study being prepared by Planning Workshop Australia. The study area included five lots occupying 48.4ha. The Site formed part of Lot 102 DP841639. As previously discussed, the study included landform, geotechnical, mineral resources, soils and agricultural capability.

Land within the Grasmere area has traditionally been used for agricultural purposes such as cattle grazing, dairy farming and occasional cropping. However since the early 1970's, these activities were reduced due to land sub-division for hobby farms and rural residential use.

The study area had not been exposed to significant agricultural activities for several years however occasional grazing and pastoral improvement were still common on Lot 102 DP841639 at the time of the study. There was evidence of past overgrazing, concurrent leaching and soil erosion.

The study area was divided into four geotechnical zones based on geology, topography and risk of slope instability. The Site formed part of Zone B described as 'flanking slopes of 5° to 10°' with a low risk of slope instability. The geology for this Zone comprised colluvial and residual soils, less than 2m depth developed on either shale or sandstone. No rock outcrops were observed on Site. However, sandstone outcrops were observed in road cuttings east of the Site and another located near residential housing located approximately 400m south of the Site. Shale outcrops were noted along Werombi Road. Inferred locations of these outcrops are shown on Figure 2.

A fill mound approximately 2.5m high and 100m long was located near the south-western boundary of Lot 102 DP841639. The exact location of this fill mound was not provided. There was no further discussion concerning the occurrence of fill materials within the study area.

Four soil samples were collected across the study area targeting depths between 0.1m and 0.5m and tested for dispersion characteristics. The closest sampling location to the Site was located approximately 15m north of the northern Site boundary. This sample was collected at 0.5m representing red-brown sandy clays; clays were medium plasticity and sands fine to medium grained.

The laboratory results indicated that non-dispersive materials were present at this location. The results for other samples were variable and more dispersive.

Vegetation occurrences were discussed in broad terms for the study area. A mixture of native and introduced grasses in particular Paspalum and Phalarius, and smaller amounts of native Sedge, Kikuyu, Couch and Clovers. There was significant intrusion of weeds in the pasture, mainly of the Feather Grass and Fireweed varieties at the time of the study. Generally few trees occupied the study area. Minimal trees comprising Red Gum, and Red and Grey Box varieties generally occupied southern parts of the study area, south of the Site.

4.3 Site Classification (Geotechnique, 2005)

The majority of test pit locations were positioned in the subdivision area located west of the site. One test pit appears to have been positioned within the southern portion of the site immediately south of the cul-de-sac. The report indicates this test pit was excavated during previous geotechnical investigations. The subsurface conditions were similar to those encountered in previous investigations. No groundwater inflows were observed within the investigation depth of 2.5m. The report noted that groundwater seepages may occur in periods of rainfall.

5 SITE HISTORY

5.1 General

Information on the Site history was obtained from:

- Review of selected aerial photographs;
- A historical land title search to review previous landowners and possible past uses of the Site;
- Interviews with available people familiar with the history and operations of the Site;
- A search of NSW EPA register for listings of the Site and nearby Sites;
- A review of Camden Council records and planning certificate; and
- A search of dangerous goods licenses held for the Site by WorkCover.

The Site history information is presented in Appendix C to G and a summary is provided below.

5.2 Summary of Site History

The general chronology of the site land use history is summarised below:

- Prior to 1901 – unknown;
- 1901 to 1945 – owned by farmers/graziers;
- 1945 to 1955 – owned by a clerk and hotel keeper;
- 1955 to 1989 – owned by several government departments;
- 1989 to 2003 – owned by University of Sydney for grazing use;
- 2003 to current – owned by two company entities;
- 2005 – subdivision of Lot 1. Site formed part of Lot 102; and
- 2012 – subdivision of Lot 102. Site formed part of Lot 24.

Site history information indicates that the site has been used for grazing land since at least the 1900's. The site had formed part of a larger parcel of land (48.4ha) and has been progressively subdivided from 2005 into smaller lots. Apart from the construction of a cul-de- sac and stormwater drain (directing water from the cul-de- sac to watercourse west of the site) circa 2007, no other activities are known to have occurred on the site.

A representative from University of Sydney provided information of site activities during their tenure on the site. The University representative was involved with the site for approximately 20 years. The site was used as part of the University's agricultural / veterinarian program where a variety of sheep, cattle and horses grazed at the site. The animals were periodically transported to another property located on Mayfarm Road, where they were treated for ticks, worms and other parasites. Mayfarm Road is located approximately 3km west of the site. No chemicals (e.g. pesticides, fuels, etc) were stored onsite and no tick dips were used to manage animal parasites. Any animals that died at the site were taken to the University for dissection and further study. No crops, ploughing or filling took place during the University's tenure. The site eventually become surplus to the University's needs and was sold in 2003.

Council records indicate that a development application (DA) for student accommodation, education and associated seminars/functions was submitted for Lot 1 in 1991. Based on aerial photographs, it is likely this building was constructed south or southeast of the site. Another DA was submitted to Council for the construction of a brick stables building for Lot 24 in 2007. Based on other site history information and site observations construction of this building has not commenced. Council indicate their records do not extend past 1991 and have no record of complaints or other information pertaining to the site. A copy of these DA's is included in Appendix D.

The planning certificate for the site (under Section 149 of the Environmental Planning and Assessment Act, 1979) indicates the land is not subject to any notifications under the Contaminated Land Management Act 1997.

The WorkCover search of the Stored Chemical Information Database (SCID) for licenses to keep dangerous goods indicated that no records pertaining to dangerous goods storage existed for the site.

There are currently no notices on the NSW EPA contaminated land record.

The following gaps in the site history are noted:

- Limited information is available on the early history of the site and therefore, some site activities may not have been identified.

5.3 Historical Information for Surrounding Areas

The University representative provided anecdotal information concerning the early history of the area but was unclear if there was a direct relationship to the site. This information included:

- A boys home "on top of the hill" (presumably south or southeast of the site) operated by the Department of Youth and Community Services between 1980 and 1989; and
- Unspecified use of the area by the Department of Defence during World War 2. Based on property title information, the Commonwealth did not acquire the site until 1955 and prior to this was privately owned. This would suggest the site was not used by Department of Defence.

Although the site appears to have remained generally undeveloped, surrounding properties to the east, south and west have progressively transformed from grazing land to rural / residential land use. Northeast of the site, a sewerage treatment plant was constructed circa 1975. The dams west of the site were progressively constructed starting prior to 1954 and completed by circa 1975.

In the 1954 aerial photograph, a structure and driveway was evident in the northeastern corner of Lot 24, but had been removed by 1965. Other evidence of activities on the remaining parts of Lot 24 was not observed until 2007. In 2007, two patches of exposed soils were observed north of the site. Although some grass cover has re-established across these areas since 2007, exposed soil is still evident.

6 SITE OBSERVATIONS

An environmental scientist made observations of the Site and nearby surrounds on 21 October 2013 during a site walkover. A summary of the relevant observations made is described below, with the Site layout and relevant features shown in Figure 2. An aerial photograph showing the current Site is presented in Figure 2. Relevant Site photographs (Plates 1 to 6) are also presented in Appendix H.

The Site was irregular in shape and except for a cul-de-sac occupying the southeastern portion of the site was vacant (i.e. no buildings/structures present). The Site was accessible from Crase Place which terminated within the southeastern portion of the site. The northern and eastern site boundaries were defined by a wooden fence and the western boundary by a serious of dams, connecting watercourses and a chain wire fence. Chain wire fencing was used along parts of the southern boundary to define the property boundary between residential Lots and the site.

The Site and remaining parts of Lot 24 are situated on the western slope of a local rise (Plate 3). The ground surface has a moderate downward slope (ranging between 5% and 10%) mostly towards the west with some cross slope towards the north (Plate 3). At the base of these slopes were a series of local depression, which at the time of the site visit were dry and firm underfoot (Plates 1, 2 and 5). During periods of heavy rain, water is likely to accumulate in these areas causing saturated ground conditions. These areas generally correlated with darker green zones observed on aerial photographs.

The Site and remaining parts of Lot 24 were generally grass covered with some patches of exposed soil (Plates 2 and 5). One of these patches was located adjacent to the southern boundary and may be associated with the construction of the adjoining residential dwelling (Plates 2 and 4). Some gravel fill was observed in this area. The other two patches of exposed soil were located north of the site and corresponded to exposed ground observed in the 2007 aerial photograph (Plate 5). At the time of the site walkover some grass cover had re-established in these areas. Some brick fragments were observed suggesting these exposed areas may have been associated with a localised filling event during construction of nearby residential dwellings (Plate 6).

Evidence of a slight depression was observed between the cul-de-sac and watercourses west of the site. This depression is consistent with that observed in the 2007 aerial photograph and appears to be associated with the stormwater drainage system. This depression is also consistent with the drainage easement shown on title diagrams (Appendix E). The drainage appears to capture water accumulated within the cul-de-sac and directs it towards the watercourses located west of the site. No other structures or infrastructure was observed on the site. A building once occupied the northeastern corner of Lot 24 (offsite) circa 1954. Evidence of this former structure was not apparent during the site walkover however the long grass may have obscured any remnants.

There was no evidence of salinity indicators onsite such as yellowing vegetation or dieback, scalding or efflorescence. No groundwater seepages or springs were observed.

Apart from some localised filling in offsite areas, no other evidence of potentially contaminating activities or indications of contamination (such as oil staining, etc) was observed.

7 DISCUSSION

7.1 Contamination

Site history information and site observations indicate that site activities have generally been associated with grazing and the site has remained undeveloped. Activities and potential sources of contamination associated with this land use could have potentially included:

- Importing fill of unknown quality and origin;
- Potential weathering of hazardous building materials, demolition of site structures and use of pesticides near buildings;
- Storage of fuels and chemicals in former farming buildings and sheds;
- Use of pesticides for treating parasites on livestock;
- Filling of disused farm dams with waste materials;
- Burial of deceased livestock.

The likelihood of these activities and potential sources of contamination occurring onsite and associated Contaminants of Potential Concern (COPCs) based on site history and observation information is discussed in Table 4.

Table 4: Summary of Potentially Contaminating Activities, Potential Areas of Environmental Concern, Likelihood of Contamination and Contaminants of Potential Concern

Potentially Contaminating Activity/Source	Sub Component / Description	Potential Areas of Environmental Concern (See also Figure 2)	Likelihood of Contamination*	Potential Chemicals of Concern
Fill of Unknown Origin and Quality	Surplus soil (cut materials) transferred to site during construction of neighbouring subdivisions south and southeast of the site.	Localised areas near the northern site boundary and near the southern boundary adjacent recently constructed residential dwellings. *Soil and groundwater media potentially impacted.*	Low likelihood of contamination and appears to be localised. Geotechnical reports did not identify fill at the site. The fill material appears to have been derived from excavation of natural soils although some brick fragments were observed in filled areas near the northern boundary. Some gravel fill was observed near the southern boundary and possibly associated with the distribution of excess materials following construction of the adjoining residential dwelling. No other evidence of construction materials was observed on the ground surface near filled areas.	TRH, BTEX, PAH, OCP, OPP, PCB, heavy metals, asbestos
Potential weathering of hazardous building materials, demolition of site structures and use of pesticides near buildings	Weathering of hazardous building materials such as lead paint, fibre cement containing asbestos and galvanised iron. Potentially present from former and existing site structures. Possible use of pesticides near structures.	Typically contamination associated with this AEC is identified adjacent to former structures or in areas where demolition has taken place. *Generally near surface soil are potentially impacted.*	Very low likelihood of contamination. Site history information has not identified any structures within the site suggesting contamination associated with the use of pesticides around building and weathering of hazardous building materials is unlikely.	OCP, OPP and heavy metals, asbestos
Storage of fuels and chemicals in former farm buildings and sheds	Storage and use of fuels, oils and lubricants or other chemicals	Contamination would typically be present in near surface soils in areas where these chemicals were stored. *Soil and groundwater media potentially impacted.*	Very low likelihood of contamination. Site history information has not identified any structures onsite, storage or the use of chemicals onsite.	TRH, BTEX, PAH, OCP, OPP, arsenic
	Use of pesticides for treating parasites on livestock.	Contamination would typically occur in near designated treatment areas, such as a tick dip. Contamination would be present in both surface soil and at depth depending on the method of pesticide application. *Soil and groundwater media potentially impacted.*	Low likelihood of contamination. Site history suggests parasite management occurred offsite in recent years however limited information is available on early history for the site.	OCP, OPP, arsenic
Filling and disposal of wastes in farm dams or other areas	Filling of dams with waste materials and / or burial of dead livestock.	Contamination would typically be present within the fill materials used to fill the dam and possibly dam sediments from runoff from upslope areas. Contamination associated with livestock burial areas would be localised to burial cell. *Soil and groundwater media potentially impacted.*	Low likelihood of contamination. Three dams were constructed west of the site and are presently filled with water. Aerial photographs did not identify dams onsite or potential burial areas. The University confirmed during their tenure that dead animals were removed from site. Aerial photographs are up to 11 years apart and other site history information available prior to 1990 is limited. Filling of dams and burying dead animals were activities routinely undertaken in rural areas; and therefore it cannot be precluded that these practices did not occur at the site.	TRH, BTEX, PAH, OCP, PCB, heavy metals, asbestos, nutrients, pathogens.

* *It is important to note that this is not an assessment of financial risk associated with the AEC in the event contamination is detected, but a qualitative assessment of the probability of contamination being detected at the potential AEC, based on the site history study and field observations.*

TRH Total Recoverable Hydrocarbons
BTEX Benzene, Toluene, Ethylbenzene, Xylene
PAH Polycyclic Aromatic Hydrocarbons
PCB Polychlorinated Biphenyl
Heavy Metals arsenic, cadmium, chromium, copper, lead, nickel, mercury, zinc
OCP Organochlorine Pesticides
OPP Organophosphorus Pesticides

7.2 Salinity

The desk study has indicated that the site is located within an area of moderate salinity potential, particularly lower lying regions within the western portions of the site. Previous investigations observed sandstone near the southern and southeastern parts of the site and potentially associated with the local rise in topography. These areas are likely to pose a lower salinity potential than the lower western portions of the site.

No groundwater information was available directly relating to the site. Groundwater information from other properties in the region indicates water bearing zones encountered at depths between 3m and 5m in weathered shale. Natural springs or seepages were not observed during the site walkover however perched/shallow groundwater may daylight as springs or seepages during heavy rainfall periods. It should be noted that water bearing zones within the Bringelly Shale are typically saline.

The 2007 aerial photograph indicated potential white efflorescence in areas immediately surrounding dams, located west of the site. This white feature may also be associated with hydromulching rather than salt as vegetation growth substantially increased in later years. Potential hydromulching is consistent with site observations, as no evidence of salt impacts were noted onsite or in nearby surrounding areas.

Inappropriate development practices could mobilise the potentially saline groundwater to the surface, or lower the site surface to intercept saline soils, not just in the topographically low areas on site, but also in more elevated locations. Inappropriate practices could include:

- Excessive removal of vegetation, thereby reducing the amount of water intake by plants and increasing infiltration of rainwater into the soil, causing the water table to rise nearer the ground surface;
- Overwatering of future parks and gardens causing the water table to rise nearer the ground surface;
- Construction of retaining walls and excessive compaction can form barriers to groundwater flow, resulting in a rising groundwater table or perched water behind the wall. Saline water can also lead to damage of the retaining wall;
- Pipes extending into the groundwater zone can be corroded quicker than normal. Burst and / or leaking pipes can exacerbate the problem by rising the water table; and
- Drilling of piers, footings etc into the groundwater surface can lead to capillary rise of the groundwater table, particularly in clay soils.

8 CONCLUSIONS

8.1 Contamination

Site history information indicates that the site has been used for grazing land since at least the 1900's. The site had formed part of a larger parcel of land (48.4ha) and has been progressively subdivided since 2005 into smaller lots. Apart from installation of minor infrastructure (i.e. cul-de-sac and stormwater drain), the site has remained undeveloped. There were some gaps in the early site history which cannot preclude certain activities occurring or structures having been present at the site. Potentially contaminating activities that may occur at rural sites and may have occurred at the site include:

- Importing fill of unknown quality and origin;
- Potential weathering of hazardous building materials, demolition of site structures and use of pesticides near buildings;
- Storage of fuels and chemicals in former farming buildings and sheds;
- Use of pesticides for treating parasites on livestock;
- Filling of disused farm dams with waste materials;
- Burial of deceased livestock.

Based on the available site history information, the likelihood of these contaminating activities occurring at the site was assessed as low to very low. Further stages of investigation are not considered necessary based on information presently available.

It is recommended that an unexpected finds procedure be developed to manage potential contamination, should it be encountered during construction. Potential contamination may include, but not limited to, oil staining, building materials such as fibre cement, burial pits, fill, odours or discolouration.

8.2 Salinity

Based on literature review and topography, the site has been assessed to have a low to moderate salinity potential. A low salinity potential is expected in hill crest/sandstone areas and transitioning to a moderate potential in the lower lying regions near the western site boundary. Further investigation is required to confirm this assessment along with developing appropriate strategies for managing the level of salinity present at the site. Further investigations can be undertaken at a future stage, for example, as part of a development application.

Salinity issues can be exacerbated through inappropriate development practices, which can alter groundwater levels, or disturb soils and mobilise salt to the surface, where it can come into contact with structures. The following management strategies and options are provided for preliminary planning purposes only. Further investigation would be best undertaken once more details are known with respect to the proposed development.

Options that may be used to mitigate the effects of potential saline soils or groundwater on the site include the following:

- Minimising water infiltration;
- Landscaping using salt-tolerant native plants in areas identified with slightly saline soils;
- Sealing the base of stormwater detention ponds;
- Retaining as much deep-rooted vegetation on site as possible;
- Minimising soil disturbance such as compaction and cut and fill;
- Water proofing slab work;
- Provide good site drainage to prevent water-logging;
- The use of higher strength concrete with thicker cover and exposure class masonry;
- Minimise disturbance on groundwater flow caused by utility trenches; and
- Soils replaced in their original order if deep (<1m) excavations are undertaken.

9 LIMITATIONS

Limited information is available on the early history of the site and therefore, some site activities may not have been identified. In addition, aerial photographs are up to 11 years apart and other site history information available prior to 1990 is limited. We cannot preclude that potentially contaminating activities took place during these periods. Allowances for uncertainties and potential unexpected finds should be made during planning and development phases.

In preparing this report, Coffey has relied on information in reports made available to Coffey by the client and prepared by other consultants. Coffey has assumed that these consultants performed the scope of works in general accordance with standard industry procedures and guidance materials at the time and that the information is suitable.

We draw your attention to the attached sheet titled "Important Information about your Coffey Environmental Report" which must be read in conjunction with this report.

10 REFERENCES

1. **Coffey Geosciences Pty Ltd (1999)** *Grasmere Local Environmental Study – Land Capability Study*, southwest corner of Werombi Road and Old Oaks Road, Grasmere (Report Ref: S20166/1-AG, dated 28 July 1999);
2. **Geological Survey of NSW (1985)** *1:100,000 Wollongong to Port Hacking Geological Series Sheet No. 9029-9129*, edition 1;
3. **Geotechnique Pty Ltd (2005)** *Site Classification for Proposed Subdivision*, Cnr Werombi and Old Oakes Roads, Grasmere (Report Ref: 10255/2-AA, dated 4 July 2005);
4. **NEPC (1999)** *National Environmental Protection (Assessment of Site Contamination) Measure 1999*, National Environment Protection Council;
5. **NEPC (2013)** *National Environmental Protection (Assessment of Site Contamination) Measure 1999*, as amended in 2013, National Environment Protection Council;
6. **NSW DEC (2006)** *Guidelines for the NSW Auditor Scheme,* 2nd Ed;
7. **NSW Department of Infrastructure, Planning and Natural Resources (2003)** *Salinity Potential in Western Sydney 2002*;
8. **NSW Department of Information, Technology and Management (2000)** *Camden 1:25,000 Topographic Map 9029-4N*, 3rd Edition;
9. **NSW OEH (2000)** *Guidelines for Reporting on Contaminated Sites*;
10. **Regional GTS Pty Ltd (1995)** *Geotechnical Assessment for proposed residential development*, Lots 100, 102 and Part 1 Old Oakes Road, Camden (Report Ref: 95225/GK/1, dated 8 August 1995).

Important information about your **Coffey** Environmental Report

Introduction

This report has been prepared by Coffey for you, as Coffey's client, in accordance with our agreed purpose, scope, schedule and budget.

The report has been prepared using accepted procedures and practices of the consulting profession at the time it was prepared, and the opinions, recommendations and conclusions set out in the report are made in accordance with generally accepted principles and practices of that profession.

The report is based on information gained from environmental conditions (including assessment of some or all of soil, groundwater, vapour and surface water) and supplemented by reported data of the local area and professional experience. Assessment has been scoped with consideration to industry standards, regulations, guidelines and your specific requirements, including budget and timing. The characterisation of site conditions is an interpretation of information collected during assessment, in accordance with industry practice,

This interpretation is not a complete description of all material on or in the vicinity of the site, due to the inherent variation in spatial and temporal patterns of contaminant presence and impact in the natural environment. Coffey may have also relied on data and other information provided by you and other qualified individuals in preparing this report. Coffey has not verified the accuracy or completeness of such data or information except as otherwise stated in the report. For these reasons the report must be regarded as interpretative, in accordance with industry standards and practice, rather than being a definitive record.

Your report has been written for a specific purpose

Your report has been developed for a specific purpose as agreed by us and applies only to the site or area investigated. Unless otherwise stated in the report, this report cannot be applied to an adjacent site or area, nor can it be used when the nature of the specific purpose changes from that which we agreed.

For each purpose, a tailored approach to the assessment of potential soil and groundwater contamination is required. In most cases, a key objective is to identify, and if possible quantify, risks that both recognised and potential contamination pose in the context of the agreed purpose. Such risks may be financial (for example, clean up costs or constraints on site use) and/or physical (for example, potential health risks to users of the site or the general public).

Limitations of the Report

The work was conducted, and the report has been prepared, in response to an agreed purpose and scope, within time and budgetary constraints, and in reliance on certain data and information made available to Coffey.

The analyses, evaluations, opinions and conclusions presented in this report are based on that purpose and scope, requirements, data or information, and they could change if such requirements or data are inaccurate or incomplete.

This report is valid as of the date of preparation. The condition of the site (including subsurface conditions) and extent or nature of contamination or other environmental hazards can change over time, as a result of either natural processes or human influence. Coffey should be kept appraised of any such events and should be consulted for further investigations if any changes are noted, particularly during construction activities where excavations often reveal subsurface conditions.

In addition, advancements in professional practice regarding contaminated land and changes in applicable statues and/or guidelines may affect the validity of this report. Consequently, the currency of conclusions and recommendations in this report should be verified if you propose to use this report more than 6 months after its date of issue.

The report does not include the evaluation or assessment of potential geotechnical engineering constraints of the site.

Interpretation of factual data

Environmental site assessments identify actual conditions only at those points where samples are taken and on the date collected. Data derived from indirect field measurements, and sometimes other reports on the site, are interpreted by geologists, engineers or scientists to provide an opinion about overall site conditions, their likely impact with respect to the report purpose and recommended actions.

Variations in soil and groundwater conditions may occur between test or sample locations and actual conditions may differ from those inferred to exist. No environmental assessment program, no matter how comprehensive, can reveal all subsurface details and anomalies. Similarly, no professional, no matter how well qualified, can reveal what is hidden by earth, rock or changed through time.

The actual interface between different materials may be far more gradual or abrupt than assumed based on the facts obtained. Nothing can be done to change the actual site conditions which exist, but

steps can be taken to reduce the impact of unexpected conditions.

For this reason, parties involved with land acquisition, management and/or redevelopment should retain the services of a suitably qualified and experienced environmental consultant through the development and use of the site to identify variances, conduct additional tests if required, and recommend solutions to unexpected conditions or other unrecognised features encountered on site. Coffey would be pleased to assist with any investigation or advice in such circumstances.

Recommendations in this report

This report assumes, in accordance with industry practice, that the site conditions recognised through discrete sampling are representative of actual conditions throughout the investigation area. Recommendations are based on the resulting interpretation.

Should further data be obtained that differs from the data on which the report recommendations are based (such as through excavation or other additional assessment), then the recommendations would need to be reviewed and may need to be revised.

Report for benefit of client

Unless otherwise agreed between us, the report has been prepared for your benefit and no other party. Other parties should not rely upon the report or the accuracy or completeness of any recommendation and should make their own enquiries and obtain independent advice in relation to such matters.

Coffey assumes no responsibility and will not be liable to any other person or organisation for, or in relation to, any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in the report.

To avoid misuse of the information presented in your report, we recommend that Coffey be consulted before the report is provided to another party who may not be familiar with the background and the purpose of the report. In particular, an environmental disclosure report for a property vendor may not be suitable for satisfying the needs of that property's purchaser. This report should not be applied for any purpose other than that stated in the report.

Interpretation by other professionals

Costly problems can occur when other professionals develop their plans based on misinterpretations of a report. To help avoid misinterpretations, a suitably qualified and experienced environmental consultant should be retained to explain the implications of the report to other professionals referring to the report and then review plans and specifications produced to see how other professionals have incorporated the report findings.

Given Coffey prepared the report and has familiarity with the site, Coffey is well placed to provide such assistance. If another party is engaged to interpret the recommendations of the report, there is a risk that the contents of the report may be misinterpreted and Coffey disowns any responsibility for such misinterpretation.

Data should not be separated from the report

The report as a whole presents the findings of the site assessment and the report should not be copied in part or altered in any way. Logs, figures, laboratory data, drawings, etc. are customarily included in our reports and are developed by scientists or engineers based on their interpretation of field logs, field testing and laboratory evaluation of samples. This information should not under any circumstances be redrawn for inclusion in other documents or separated from the report in any way.

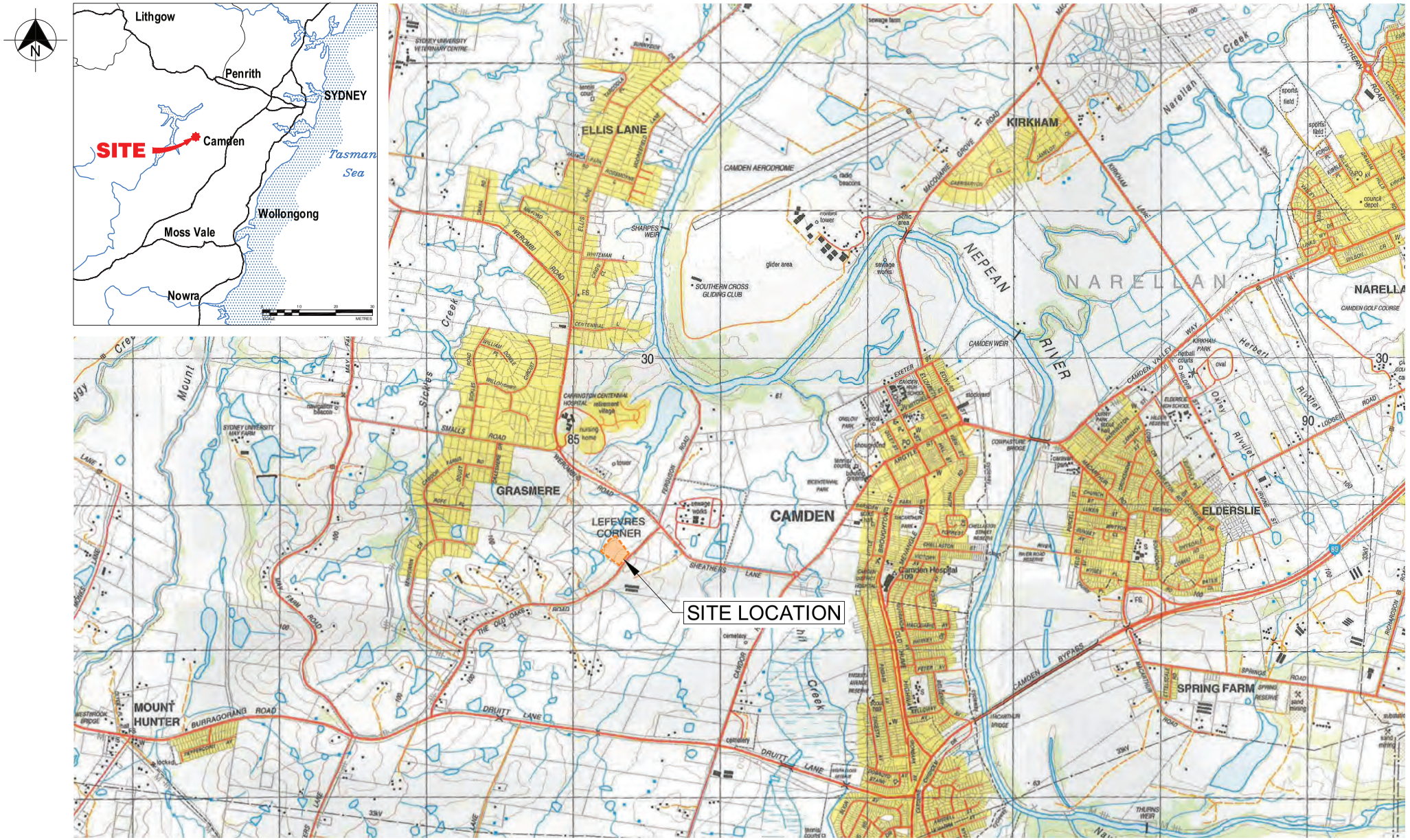
This report should be reproduced in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties.

Responsibility

Environmental reporting relies on interpretation of factual information using professional judgement and opinion and has a level of uncertainty attached to it, which is much less exact than other design disciplines. This has often resulted in claims being lodged against consultants, which are unfounded. As noted earlier, the recommendations and findings set out in this report should only be regarded as interpretive and should not be taken as accurate and complete information about all environmental media at all depths and locations across the site.

Figures

Phase 1 Contamination Assessment and Salinity Assessment
Part Lot 24 DP1086823, 10 Crase Place,
Grasmere, NSW



SOURCE: NSW DEPARTMENT OF INFORMATION, TECHOLOGY AND MANAGEMENT (2000)
CAMDEN 1:25,000 TOPOGRAPHIC MAP 9029-4-N, 3rd EDITION

revision	description	drawn	approved	date

drawn	LZ
approved	SR
date	1.10.13
scale	1:25000
original size	A3

coffey

client: SITE PLUS

project: PHASE 1 CONTAMINATION ASSESSMENT & SALINITY ASSESSMENT PART LOT 24 DP1086823, 10 CRASE PLACE, GRASMERE, NSW

title: SITE LOCALITY PLAN

project no: ENAUWOLL04150AA-R01

figure no: 1

AERIAL IMAGE SOURCE: GOOGLE EARTH PRO 6.0.1

revision	description	drawn	approved	date

20 0 20 40 60 80 100

Scale (metres) 1:2000

drawn	LZ
approved	SR
date	1.10.13
scale	1:2000
original size	A3

coffey

client: SITE PLUS

project: PHASE 1 CONTAMINATION ASSESSMENT & SALINITY ASSESSMENT PART LOT 24 DP1086823, 10 CRASE PLACE, GRASMERE, NSW

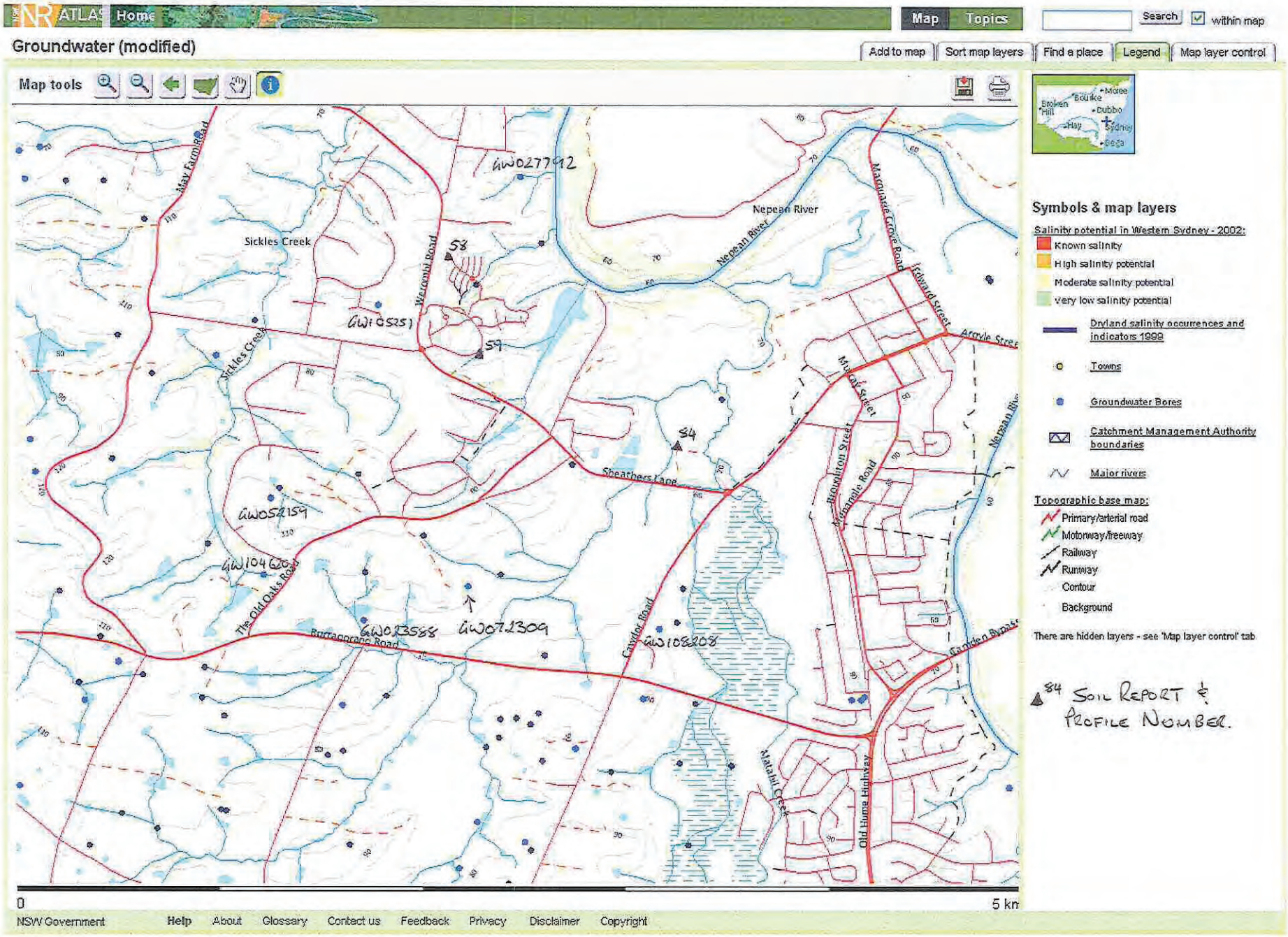
title: SITE LAYOUT PLAN SHOWING SITE FEATURES

project no: ENAUWOLL04150AA-R01

figure no: 2

Appendix A
Registered Groundwater Bore Search Results and SALIS Report

Phase 1 Contamination Assessment and Salinity Assessment
Part Lot 24 DP1086823, 10 Crase Place,
Grasmere, NSW


NR ATLAS Home
Map Topics
Search within map
Groundwater (modified)
Add to map
Sort map layers
Find a place
Legend
Map layer control
Map tools
Sickles Creek
Nepean River
Werombi Road
May Farm Road
Sheathers Lane
Brittagorang Road
The Old Oaks Road
Taylor Road
Old Hume Highway
Macquarie Grove Road
Argyle Street
Broughton Street
Menangle Road
Camden Bypass
Matahil Creek
GW027792
GW105251
GW052159
GW104620
GW073588
GW072309
GW108208
S3
S4
S9
Symbols & map layers
Salinity potential in Western Sydney - 2002:
Known salinity
High salinity potential
Moderate salinity potential
Very low salinity potential
Dryland salinity occurrences and indicators 1999
Towns
Groundwater Bores
Catchment Management Authority boundaries
Major rivers
Topographic base map:
Primary/arterial road
Motorway/freeway
Railway
Runway
Contour
Background
There are hidden layers - see 'Map layer control' tab
S4 Soil Report & Profile Number.
0
5 km
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Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Thursday, October 17, 2013

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW023588

Works Details (top)

GROUNDWATER NUMBER	GW023588
LIC-NUM	10WA109654
AUTHORISED-PURPOSES	STOCK
INTENDED-PURPOSES	IRRIGATION
WORK-TYPE	Bore open thru rock
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	Cable Tool
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	1965-01-01
FINAL-DEPTH (metres)	91.40
DRILLED-DEPTH (metres)	91.40
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	BOARDMAN
GWMA	-
GW-ZONE	-
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	10 - SYDNEY SOUTH COAST
RIVER-BASIN	212 - HAWKESBURY RIVER
AREA-DISTRICT	
CMA-MAP	9029-4N
GRID-ZONE	56/1
SCALE	1:25,000
ELEVATION	
ELEVATION-SOURCE	(Unknown)
NORTHING	6227676.00
EASTING	284629.00
LATITUDE	34 4' 10"
LONGITUDE	150 39' 58"
GS-MAP	0075C1

AMG-ZONE	56
COORD-SOURCE	GD.,ACC.MAP
REMARK	

Form-A (top)

COUNTY	CAMDEN
PARISH	CAMDEN
PORTION-LOT-DP	12

Licensed (top)

COUNTY	CAMDEN
PARISH	CAMDEN
PORTION-LOT-DP	7 1078000

Construction (top)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE-NO	PIPE-NO	COMPONENT-CODE	COMPONENT-TYPE	DEPTH-FROM (metres)	DEPTH-TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1	1	Casing	Threaded Steel	-0.60	71.60	127			(Unknown)

Water Bearing Zones (top)

FROM-DEPTH (metres)	TO-DEPTH (metres)	THICKNESS (metres)	ROCK-CAT-DESC	S-W-L	D-D-L	YIELD	TEST-HOLE-DEPTH (metres)	DURATION	SALINITY
5.40	5.40	0.00	(Unknown)			0.00			(Unknown)
27.40	33.40	6.00	Fractured	3.60		1.26			V.Salty
86.50	86.50	0.00	Consolidated (natural flow)	-0.60					invalid code

Drillers Log (top)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	5.48	5.48	Clay		
5.48	8.53	3.05	Clay Shale Water Supply		
8.53	70.10	61.57	Shale Water Supply		
70.10	91.44	21.34	Sandstone Water Supply		

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Thursday, October 17, 2013

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW072309

Works Details (top)

GROUNDWATER NUMBER	GW072309
LIC-NUM	
AUTHORISED-PURPOSES	
INTENDED-PURPOSES	FARMING STOCK
WORK-TYPE	Bore
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	Rotary Air
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	1994-07-15
FINAL-DEPTH (metres)	30.00
DRILLED-DEPTH (metres)	30.00
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	
GWMA	
GW-ZONE	
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	10 - SYDNEY SOUTH COAST
RIVER-BASIN	212 - HAWKESBURY RIVER
AREA-DISTRICT	
CMA-MAP	9029-4N
GRID-ZONE	56/1
SCALE	1:25,000
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6227902.00
EASTING	285170.00
LATITUDE	34 4' 3"
LONGITUDE	150 40' 19"
GS-MAP	

AMG-ZONE	56
COORD-SOURCE	
REMARK	

Form-A (top)

COUNTY	CAMDEN
PARISH	CAMDEN
PORTION-LOT-DP	LPT19 DP975392

Licensed (top)

no details

Water Bearing Zones (top)

no details

Drillers Log (top)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	1.00	1.00	Soil & Clay		
1.00	10.00	9.00	Brown Shale		
10.00	30.00	20.00	Blue Shale		

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Thursday, October 17, 2013

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW105251

Works Details (top)

GROUNDWATER NUMBER	GW105251
LIC-NUM	10WA111036
AUTHORISED-PURPOSES	DOMESTIC STOCK
INTENDED-PURPOSES	DOMESTIC STOCK
WORK-TYPE	Bore
WORK-STATUS	Supply Obtained
CONSTRUCTION-METHOD	Rotary
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	2003-10-03
FINAL-DEPTH (metres)	162.00
DRILLED-DEPTH (metres)	162.00
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	ROMEO
GWMA	-
GW-ZONE	-
STANDING-WATER-LEVEL	40.00
SALINITY	1260.00
YIELD	0.30

Site Details (top)

REGION	10 - SYDNEY SOUTH COAST
RIVER-BASIN	212 - HAWKESBURY RIVER
AREA-DISTRICT	
CMA-MAP	9029-4N
GRID-ZONE	56/1
SCALE	1:25,000
ELEVATION	
ELEVATION-SOURCE	(Unknown)
NORTHING	6229667.00
EASTING	284660.00
LATITUDE	34 3' 6"
LONGITUDE	150 40' 1"
GS-MAP	

AMG-ZONE	56
COORD-SOURCE	
REMARK	

Form-A (top)

COUNTY	CAMDEN
PARISH	CAMDEN
PORTION-LOT-DP	116 854483

Licensed (top)

COUNTY	CAMDEN
PARISH	CAMDEN
PORTION-LOT-DP	116 854483

Construction (top)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE-NO	PIPE-NO	COMPONENT-CODE	COMPONENT-TYPE	DEPTH-FROM (metres)	DEPTH-TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1		Hole	Hole	0.00	5.50	208			Rotary Air
1		Hole	Hole	5.50	162.00	158			Down Hole Hammer
1	1	Casing	Steel	-0.50	5.50	168.3	158.7		C: -.1-5.5m; Driven into Hole
1	1	Casing	PVC Class 9	-0.50	71.50	140			Screwed and Glued; Suspended in Clamps

Water Bearing Zones (top)

FROM-DEPTH (metres)	TO-DEPTH (metres)	THICKNESS (metres)	ROCK-CAT-DESC	S-W-L	D-D-L	YIELD	TEST-HOLE-DEPTH (metres)	DURATION	SALINITY
28.00	30.00	2.00				0.05	36.00	0.25	3200.00
86.00	89.00	3.00				0.20	90.00	0.25	960.00
109.00	110.50	1.50				0.30	114.00	0.25	940.00
122.00	124.00	2.00		40.00		0.30	162.00	0.25	1260.00

Drillers Log (top)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	3.00	3.00	CLAY STIFF		
3.00	5.00	2.00	CLAY SILTY WET		
5.00	65.00	60.00	SHALE HARD		

65.00	70.00	5.00	SANDSTONE GREY
70.00	72.00	2.00	SHALE
72.00	86.00	14.00	SANDSTONE GREY
86.00	89.00	3.00	SANDSTONE FINE QUARTZ
89.00	109.00	20.00	SANDSTONE GREY
109.00	110.50	1.50	SANDSTONE QUARTZ
110.50	114.50	4.00	SANDSTONE GREY
114.50	117.00	2.50	SHALE
117.00	122.00	5.00	SANDSTONE GREY
122.00	124.00	2.00	SANDSTONE QUARTZ
124.00	130.00	6.00	SANDSTONE GREY
130.00	131.00	1.00	SANDSTONE FRACTURED QUARTZ
131.00	139.00	8.00	SANDSTONE GREY
139.00	140.00	1.00	SANDSTONE QUARTZ
140.00	151.00	11.00	SANDSTONE GREY
151.00	162.00	11.00	SHALE

LOCATION: Grasmere nr Carrington Centennial Hospital

SURVEY: Wollongong II NHT (1004364)

PROFILE: 58

PROFILE MAP DETAILS:

1:100,000 Mapsheet:	WOLLONGONG (9029)	Scale of Mapping:	other
MGA Easting:	285018	MGA Northing:	6230010

SITE DETAILS:

Described by:	Andrew Macleod	Profile Date:	January 29, 2003
Nature of Exposure:	batter	Photo Taken:	
No of Layers:	2		

SOIL AND MAP CODES:

Geology Map Code:	Rwb	Soil Map Code:	bt
Aust. Soil Classification:	Kurosol, Brown, Natric, Haplic, Haplic, All required data available		
Great Soil Group:	Soloth (Solod)	Northcote PPF:	
Soil Taxonomy:		Atlas (Northcote) Code:	
Atlas (A&M) Code:			

TOPOGRAPHY:

Slope:	3%, ?		
Elevation:	90 m	Aspect:	west

LANDFORM:

Site Morphology:	upper slope	Site Process:	90 m
Slope Morphology:	waxing	Local Relief:	very low (9-30 m)
Landform Pattern:		Landform Element:	hillcrest
Microrelief			
Pos in LF Element:		Plan Curvature:	

LITHOLOGY:

Solum PM:	shale	Substrate:	shale m
Rock Outcrop:	nil	Outcrop Same As:	

Substrate Strength:	moderately strong
Weathering & Alteration:	highly weathered rock m
Discontinuities:	
Fragment Amount:	

VEGETATION:

Vegetation Community:	woodland grass u'storey
Growth Form(s):	tree,shrub,tussock grass
Crown Separation Ratio:	
Upper Stratum Height:	

Species: Dendrobium aemulum (ironbark orchid)

SITE CONDITION:

Ground Cover %:	99	Site Disturbance:	extensive clearing
Current Condition(s):	firm	Expected Dry Condition:	hardsetting

LAND USE:

Site:	volun./native pasture	General Area:	urban,volun./native pasture,improved pasture

HYDROLOGY:

Presence of Free Water:	none	Free Water Depth:	
Run-on:	low	Run-off:	low
Permeability:	slowly permeable	Profile Drainage:	imperfectly drained
Free Water pH:		Free Water Salinity:	

EROSION: none

EROSION HAZARD: moderate

SALINITY: no salting evident

FIELD NOTES: Soil underlain by highly weathered and broken-up shale fragments (C horizon) - greyish coloured Bringelly shale.

PROFILE ADDENDUM:

SOIL DESCRIPTION:

LAYER 0	horizon
Depth:	00.00 - 00.00

COARSE FRAGMENTS:

Type:	not evident	Amount:		Distribution:	Orientation:	Weathering:
Shape:						
Size:						
Type:	not evident	Amount:		Distribution:	Orientation:	Weathering:
Shape:						
Size:						

LAYER 1 A1 horizon
Depth: 00.00 - 00.25

TEXTURE: medium clay loam

COLOUR:
Moist: strong brown (bright brown) (7.5YR 5/6)
Dry:

FIELD CHEMICAL TESTS:
pH: 5 (Raupach)

STRUCTURE:

Grade of Pedality:	moderate pedality	Fabric:	rough-faced peds
Dominant Peds:	10 - 20 mm,polyhedral		
Subdominant Peds:	5 - 10 mm,sub-angular blocky		
Artificial Aggregates:			

COARSE FRAGMENTS:

Type:	not evident	Amount:		Distribution:	Orientation:	Weathering:
Shape:						
Size:						
Type:	not evident	Amount:		Distribution:	Orientation:	Weathering:
Shape:						
Size:						

ROOTS:

<1 mm size:	few (1-10/10x10cm)	1-2 mm size:	few (1-10/10x10cm)	2-5 mm size:	>5 mm size:	

CRACKS AND MACROPORES:

Cracks						
<5 mm width:	evident	5-10 mm width:	evident	10-20 mm width:	20-50 mm width:	>50 mm width:
Macropores						
<1 mm size:		1-2 mm size:		2-5 mm size:	>5 mm size:	

CONSISTENCE:

Degree of Plasticity:		Stickiness:	moderately sticky
Texture Modifier:	increase < 2 Grades	Disruptive Test:	moderately strong force
Shearing Test:	crumbly	Toughness:	

SOIL WATER STATUS: dry

ERODIBILITY TESTS:

Crumb Test:	no change	Bolus Formation:	Field Dilatency:

SOIL ERODIBILTY: low

SAMPLE TAKEN: bulked

BOUNDARY:

Distinctiveness:	abrupt (5-20 mm)	Shape:	smooth

LAYER 2 B2 horizon
Depth: 00.25 - 00.55

TEXTURE: medium clay

COLOUR:
Moist: yellowish brown (dull yellowish brown) (10YR 5/4)
Dry:

FIELD CHEMICAL TESTS:
pH: 5.5 (Raupach)

STRUCTURE:

Grade of Pedality:	strong pedality	Fabric:	rough-faced peds

Dominant Peds: 5 - 10 mm,polyhedral
Subdominant Peds: 2 - 5 mm,sub-angular blocky
Artificial Aggregates:

COARSE FRAGMENTS:
Type: not evident Amount: Distribution: Orientation: Weathering:
Shape:
Size:
Type: not evident Amount: Distribution: Orientation: Weathering:
Shape:
Size:

CONSISTENCE:

Degree of Plasticity:		Stickiness:	very sticky
Texture Modifier:	increase < 2 Grades	Disruptive Test:	moderately strong force
Shearing Test:	crumbly	Toughness:	

SOIL WATER STATUS: dry

ERODIBILITY TESTS:

Crumb Test:	aggregates	Bolus	Field

disperse Formation: Dilatency:

SOIL ERODIBILTY: moderate

SAMPLE TAKEN: disturbed

LAYER NOTES: Most likely sodic. Some silt. Minor dispersion, but doesn't slake.

BOUNDARY:
Distinctiveness: clear (20-50 mm) Shape: smooth

LAYER 99 horizon
Depth: 00.68 -

LABORATORY TESTS:

Sample No:	99
Depth:	00.00 - 00.00 m
Test Results:	
N504.99 [Oven-dry moisture content]:	4.0
N518.99 [Volume expansion]:	7
N517.99_CL [PSA clay - SDS]:	34
N517.99_SI [PSA silt - SDS]:	19
N517.99_FS [PSA fine sand - SDS]:	14
N517.99_CS [PSA coarse sand - SDS]:	2
N517.99_GR [PSA gravel - SDS]:	31
N514.99 [Dispersion percentage]:	25
N513.98 [Emerson aggregate test SCS method]:	3(1)
N550.01 [USCS - lab]:	CL
N504.02_FC [Field Capacity, SWC pressure plate]:	30.3
N504.02_PWP [Permanent Wilt Point, SWC pressure plate]:	14.9
N515.99 [Wind erodible aggregate percentage]:	23
N505.99 [Water repellence field method]:	1
N3A1 [EC of 1:5 soil/water extract]:	0.06
N4A1 [pH of 1:5 soil/water suspension]:	5.3
N4B1 [pH of 1:5 soil/0.01M CaCl2 extract - direct, no stir]:	4.3
N15F1_CEC [CEC by 0.01M silver-thiourea (AgTU)+, no pret.]:	20.9
N15F1_CA [Exchangeable Ca - 0.01M (AgTU)+, no pretreatment]:	3.6
N15F1_MG [Exchangeable Mg - 0.01M (AgTU)+, no pretreatment]:	6.2
N15F1_NA [Exchangeable Na - 0.01M (AgTU)+, no pretreatment]:	0.7
N15F1_K [Exchangeable K - 0.01M (AgTU)+, no pretreatment]:	1.3
N15F1_AL [Exch. bases (Al+), 0.01M (AgTU)+, no pretreat.]:	4.3
N6A1 [Organic carbon - Walkley & Black]:	0.78
N9E1 [Fluoride-extractable P (Bray 1-P) - manual colour]:	2
N9I1 [Phosphate sorption index]:	599
Sample No:	100
Depth:	00.25 - 00.25 m
Test Results:	
N504.99 [Oven-dry moisture content]:	3.6
N518.99 [Volume expansion]:	5

N518.01 [Linear shrinkage]:	11.0
N517.99_CL [PSA clay - SDS]:	32
N517.99_SI [PSA silt - SDS]:	28
N517.99_FS [PSA fine sand - SDS]:	16
N517.99_CS [PSA coarse sand - SDS]:	2
N517.99_GR [PSA gravel - SDS]:	22
N514.99 [Dispersion percentage]:	63
N513.98 [Emerson aggregate test SCS method]:	2(2)
N550.01 [USCS - lab]:	CL
N504.02_FC [Field Capacity, SWC pressure plate]:	32.4
N504.02_PWP [Permanent Wilt Point, SWC pressure plate]:	15.1
N515.99 [Wind erodible aggregate percentage]:	3
N505.99 [Water repellence field method]:	2
N3A1 [EC of 1:5 soil/water extract]:	0.08
N4A1 [pH of 1:5 soil/water suspension]:	5.7
N4B1 [pH of 1:5 soil/0.01M CaCl2 extract - direct, no stir]:	4.2
N15F1_CEC [CEC by 0.01M silver-thiourea (AgTU)+, no pret.]:	20.4
N15F1_CA [Exchangeable Ca - 0.01M (AgTU)+, no pretreatment]:	2.4
N15F1_MG [Exchangeable Mg - 0.01M (AgTU)+, no pretreatment]:	7.6
N15F1_NA [Exchangeable Na - 0.01M (AgTU)+, no pretreatment]:	2.0
N15F1_K [Exchangeable K - 0.01M (AgTU)+, no pretreatment]:	1.7
N15F1_AL [Exch. bases (Al+), 0.01M (AgTU)+, no pretreat.]:	2.0
N6A1 [Organic carbon - Walkley & Black]:	0.60
N9E1 [Fluoride-extractable P (Bray 1-P) - manual colour]:	1
N9I1 [Phosphate sorption index]:	367

For information on laboratory test data and units of measure, please see the SPADE Help page

SALIS Soil Technical Report To contact us email:soils@dnr.nsw.gov.au Fri Oct 18 16:01:47 EST 2013

NSW SOIL AND LAND INFORMATION SYSTEM

Soil Technical Report

LOCATION: Werombi Rd - Lefevres Corner

SURVEY: Wollongong II NHT (1004364)

PROFILE: 59

PROFILE MAP DETAILS:

1:100,000 Mapsheet:	WOLLONGONG (9029)	Scale of Mapping:	other
MGA Easting:	285202	MGA Northing:	6229384

SITE DETAILS:

Described by:	Andrew Macleod	Profile Date:	January 29, 2003
Nature of Exposure:	batter	Photo Taken:	
No of Layers:	2		

SOIL AND MAP CODES:

Geology Map Code:	Rwb	Soil Map Code:	luz
Aust. Soil Classification:	Chromosol, Red, Mesotrophic, Haplic, Haplic, All required data available		
Great Soil Group:	Red Podzolic Soil	Northcote PPF:	
Soil Taxonomy:		Atlas (Northcote) Code:	
Atlas (A&M) Code:			

TOPOGRAPHY:

Slope:	13%, measured		
Elevation:	85 m	Aspect:	south east

LANDFORM:

Site Morphology:	upper slope	Site Process:	85 m
Slope Morphology:	waxing	Local Relief:	low (30-90 m)
Landform Pattern:		Landform Element:	hillslope
Microrelief			
Pos in LF Element:		Plan Curvature:	

LITHOLOGY:

Solum PM:	shale	Substrate:	shale m
Rock Outcrop:	nil	Outcrop Same As:	
Substrate Strength:	moderately strong		
Weathering & Alteration:	highly weathered rock m		
Discontinuities:			

Fragment Amount:

VEGETATION:

Vegetation Community:	woodland grass u'storey
Growth Form(s):	tree,shrub,tussock grass
Crown Separation Ratio:	
Upper Stratum Height:	
Species:	Eucalyptus crebra (narrow-leaved ironbark)
Species:	Eucalyptus moluccana (coastal grey box)

SITE CONDITION:

Ground Cover %:	99	Site Disturbance:	extensive clearing
Current Condition(s):	firm	Expected Dry Condition:	hardsetting

LAND USE:

Site:		General Area:	volun./native pasture,improved pasture

HYDROLOGY:

Presence of Free Water:	none	Free Water Depth:	
Run-on:	low	Run-off:	moderate
Permeability:	slowly permeable	Profile Drainage:	mod. well drained
Free Water pH:		Free Water Salinity:	

EROSION: none

EROSION HAZARD: moderate

SALINITY: no salting evident

FIELD NOTES: ? Might be salty? Shale/sandstone mix. Abundant round ironstone segregations.

PROFILE ADDENDUM:

SOIL DESCRIPTION:

LAYER 1	A1 horizon
Depth:	00.00 - 00.35

TEXTURE: medium silty clay loam

COLOUR:

Moist:	reddish brown (dull reddish brown) (5YR 4/4)
Dry:	

FIELD CHEMICAL TESTS:

FIELD CHEMICAL TESTS:

pH:	6 (Raupach)

STRUCTURE:

Grade of Pedality:	weak pedality	Fabric:	rough-faced peds
Dominant Peds:	2 - 5 mm,polyhedral		
Subdominant Peds:	5 - 10 mm		
Artificial Aggregates:			

ROOTS:

<1 mm size:	common (10-25/10x10cm)	1-2 mm size:	none	2-5 mm size:	>5 mm size:	

CRACKS AND MACROPORES:

Cracks

<5 mm width:	evident	5-10 mm width:	evident	10-20 mm width:	20-50 mm width:	>50 mm width:

Macropores

<1 mm size:	1-2 mm size:	2-5 mm size:	>5 mm size:	

CONSISTENCE:

Degree of Plasticity:		Stickiness:	moderately sticky
Texture Modifier:	increase < 2 Grades	Disruptive Test:	very firm force
Shearing Test:	crumbly	Toughness:	

SOIL WATER STATUS: dry

ERODIBILITY TESTS:

Crumb Test:	no change	Bolus Formation:	Field Dilatency:

SOIL ERODIBILTY: low

SAMPLE TAKEN: bulked

BOUNDARY:

Distinctiveness:	clear (20-50 mm)	Shape:	smooth

LAYER 2 B2 horizon

Depth: 00.35 - 00.70

TEXTURE: medium heavy clay

COLOUR:

Moist:	reddish brown (dull reddish brown) (2.5YR 4/4)
Dry:	

FIELD CHEMICAL TESTS:

pH:	5.5 (Raupach)

STRUCTURE:

Grade of Pedality:	strong pedality	Fabric:	rough-faced peds
Dominant Peds:	10 - 20 mm,sub-angular blocky		
Subdominant Peds:	20 - 50 mm		
Artificial Aggregates:			

COARSE FRAGMENTS:

Type:	ironstone	Amount:	common (10-20%)	Distribution: dispersed	Orientation: reoriented	Weathering: strongly weathered
Shape:	rounded,sub-rounded					
Size:	fine gravel (2-6 mm),gravel (6-20 mm)					

ROOTS:

<1 mm size:	none	1-2 mm size:	few (1-10/10x10cm)	2-5 mm size:	>5 mm size:	

CRACKS AND MACROPORES:

Cracks						
<5 mm width:	evident	5-10 mm width:	evident	10-20 mm width:	20-50 mm width:	>50 mm width:
Macropores						
<1 mm size:		1-2 mm size:		2-5 mm size:	>5 mm size:	

CONSISTENCE:

Degree of Plasticity:		Stickiness:	very sticky
Texture Modifier:	increase < 2 Grades	Disruptive Test:	moderately strong force
Shearing Test:	crumbly	Toughness:	

SOIL WATER STATUS: dry

ERODIBILITY TESTS:

Crumb Test:	aggregates slake	Bolus Formation:	Field Dilatency:

SOIL ERODIBILTY: moderate

SAMPLE TAKEN: disturbed

LAYER NOTES: Fairly abundant iron segregations. - very rounded iron nodules.

BOUNDARY:

Distinctiveness:	clear (20-50 mm)	Shape:	smooth

.....)

LAYER 99 horizon
Depth: 00.90 -

LABORATORY TESTS:

Sample No:	101
Depth:	00.00 - 00.00 m
Test Results:	
N504.99 [Oven-dry moisture content]:	3.2
N518.99 [Volume expansion]:	13
N517.99_CL [PSA clay - SDS]:	35
N517.99_SI [PSA silt - SDS]:	20
N517.99_FS [PSA fine sand - SDS]:	39
N517.99_CS [PSA coarse sand - SDS]:	5
N517.99_GR [PSA gravel - SDS]:	1
N514.99 [Dispersion percentage]:	12
N513.98 [Emerson aggregate test SCS method]:	5
N550.01 [USCS - lab]:	ML
N504.02_FC [Field Capacity, SWC pressure plate]:	29.4
N504.02_PWP [Permanent Wilt Point, SWC pressure plate]:	11.7
N515.99 [Wind erodible aggregate percentage]:	31
N505.99 [Water repellence field method]:	1
N3A1 [EC of 1:5 soil/water extract]:	0.05
N4A1 [pH of 1:5 soil/water suspension]:	6.5
N4B1 [pH of 1:5 soil/0.01M CaCl2 extract - direct, no stir]:	5.7
N15F1_CEC [CEC by 0.01M silver-thiourea (AgTU)+, no pret.]:	13.2
N15F1_CA [Exchangeable Ca - 0.01M (AgTU)+, no pretreatment]:	4.1
N15F1_MG [Exchangeable Mg - 0.01M (AgTU)+, no pretreatment]:	4.8
N15F1_NA [Exchangeable Na - 0.01M (AgTU)+, no pretreatment]:	0.3
N15F1_K [Exchangeable K - 0.01M (AgTU)+, no pretreatment]:	0.9
N15F1_AL [Exch. bases (Al+), 0.01M (AgTU)+, no pretreat.]:	0.5
N6A1 [Organic carbon - Walkley & Black]:	0.75
N9E1 [Fluoride-extractable P (Bray 1-P) - manual colour]:	1
N9I1 [Phosphate sorption index]:	455
Sample No:	102
Depth:	00.35 - 00.35 m
Test Results:	
N504.99 [Oven-dry moisture content]:	3.6
N518.99 [Volume expansion]:	15
N517.99_CL [PSA clay - SDS]:	40
N517.99_SI [PSA silt - SDS]:	24
N517.99_FS [PSA fine sand - SDS]:	27
N517.99_CS [PSA coarse sand - SDS]:	6
N517.99_GR [PSA gravel - SDS]:	3
N516.01_CL [Non-dispersed PSA clay]:	7
N516.01_SI [Non-dispersed PSA silt]:	46
N516.01_FS [Non-dispersed PSA fine sand]:	31
N516.01_CS [Non-dispersed PSA coarse sand]:	13
N516.01_GR [Non-dispersed PSA gravel]:	3
N514.99 [Dispersion percentage]:	10
N513.98 [Emerson aggregate test SCS method]:	5
N550.01 [USCS - lab]:	CL
N504.02_FC [Field Capacity, SWC pressure plate]:	29.3
N504.02_PWP [Permanent Wilt Point, SWC pressure plate]:	13.7

N504.02_PWP [Permanent Wilt Point, SWC pressure plate]:	13.7
N515.99 [Wind erodible aggregate percentage]:	14
N505.99 [Water repellence field method]:	2
N3A1 [EC of 1:5 soil/water extract]:	0.04
N4A1 [pH of 1:5 soil/water suspension]:	6.1
N4B1 [pH of 1:5 soil/0.01M CaCl2 extract - direct, no stir]:	5.2
N15F1_CEC [CEC by 0.01M silver-thiourea (AgTU)+, no pret.]:	16.4
N15F1_CA [Exchangeable Ca - 0.01M (AgTU)+, no pretreatment]:	2.4
N15F1_MG [Exchangeable Mg - 0.01M (AgTU)+, no pretreatment]:	5.9
N15F1_NA [Exchangeable Na - 0.01M (AgTU)+, no pretreatment]:	0.5
N15F1_K [Exchangeable K - 0.01M (AgTU)+, no pretreatment]:	0.6
N15F1_AL [Exch. bases (Al+), 0.01M (AgTU)+, no pretreat.]:	0.2
N6A1 [Organic carbon - Walkley & Black]:	0.21
N9E1 [Fluoride-extractable P (Bray 1-P) - manual colour]:	2
N9I1 [Phosphate sorption index]:	592

For information on laboratory test data and units of measure, please see the SPADE Help page

SALIS Soil Technical Report To contact us email:soils@dnr.nsw.gov.au Fri Oct 18 15:53:42 EST 2013

NSW SOIL AND LAND INFORMATION SYSTEM

Soil Technical Report

LOCATION: Sheathers Lane, near Matahil Ck

SURVEY: Wollongong II NHT (1004364)

PROFILE: 84

PROFILE MAP DETAILS:

1:100,000 Mapsheet:	WOLLONGONG (9029)	Scale of Mapping:	other
MGA Easting:	286257	MGA Northing:	6228779

SITE DETAILS:

Described by:	Andrew Macleod	Profile Date:	February 11, 2003
Nature of Exposure:	auger	Photo Taken:	
No of Layers:	3		

SOIL AND MAP CODES:

Geology Map Code:	Qal	Soil Map Code:	scy
Aust. Soil Classification:	Sodosol, Grey, Mesonatric, Eutrophic, Eutrophic, Sufficient data available		
Great Soil Group:	Gleyed Podzolic Soil	Northcote PPF:	
Soil Taxonomy:		Atlas (Northcote) Code:	
Atlas (A&M) Code:			

TOPOGRAPHY:

Slope:	1%, measured		
Elevation:	65 m	Aspect:	

LANDFORM:

Site Morphology:	flat	Site Process:	65 m
Slope Morphology:		Local Relief:	extremely low (< 9m)
Landform Pattern:		Landform Element:	plain
Microrelief			
Pos in LF Element:		Plan Curvature:	

LITHOLOGY:

Solum PM:	alluvium	Substrate:	alluvium m
Rock Outcrop:	nil	Outcrop Same	

As:

Substrate Strength:
Weathering & Alteration: m
Discontinuities:
Fragment Amount:

VEGETATION:

Vegetation Community: unknown
Growth Form(s): tree,tussock grass,sod grass
Crown Separation Ratio:
Upper Stratum Height:

Species: Casuarina sp.

SITE CONDITION:

Ground Cover %: 99
Site Disturbance: extensive clearing
Current Condition(s): firm
Expected Dry Condition:

LAND USE:

Site: improved pasture
General Area: volun./native pasture,improved pasture

HYDROLOGY:

Presence of Free Water: none
Free Water Depth:
Run-on: low
Run-off: none
Permeability: moderately permeable
Profile Drainage: well drained
Free Water pH:
Free Water Salinity:

EROSION: none

EROSION HAZARD: slight

SALINITY: salting evident

FIELD NOTES: Almost completely cleared for pasture. Floodplain of Matahil Ck. Diagram, site, 20m from channel. Heavy grey/gleyed clay at water table depth. (-50cm)

PROFILE ADDENDUM:

SOIL DESCRIPTION:

LAYER 0 horizon
Depth: 00.00 - 00.00

COARSE FRAGMENTS:

Type:	not evident	Amount:	none	Distribution:	Orientation:	Weathering:
Shape:						
Size:						
Type:	not evident	Amount:	none	Distribution:	Orientation:	Weathering:
Shape:						
Size:						

LAYER 1 A1 horizon
Depth: 00.00 - 00.25

TEXTURE: fine medium clay loam sandy

COLOUR:
Moist: dark greyish brown (greyish yellow brown) (10YR 4/2)
Dry:

FIELD CHEMICAL TESTS:
pH: 6 (Raupach)

STRUCTURE:
Grade of Pedality: massive Fabric: earthy
Dominant Peds: 2 - 5 mm,granular
Subdominant Peds: < 2 mm
Artificial Aggregates:

COARSE FRAGMENTS:

Type:	not evident	Amount:	none	Distribution:	Orientation:	Weathering:
Shape:						
Size:						
Type:	not evident	Amount:	none	Distribution:	Orientation:	Weathering:
Shape:						
Size:						

ROOTS:

<1 mm size:	common (10-25/10x10cm)	1-2 mm size:	none	2-5 mm size:	>5 mm size:

CONSISTENCE:

Degree of Plasticity:		Stickiness:	slightly sticky
Texture Modifier:	no change	Disruptive Test:	very weak force
Shearing Test:	crumbly	Toughness:	

SOIL WATER STATUS: moderately moist

ERODIBILITY TESTS:

Crumb Test:	no change	Bolus Formation:	Field Dilatency:

SOIL ERODIBILTY: low

SAMPLE TAKEN: bulked

BOUNDARY:

Distinctiveness:	abrupt (5-20 mm)	Shape:	irregular

LAYER 2 B1 horizon
Depth: 00.25 - 00.45

TEXTURE: light clay

COLOUR:

Moist:	very dark greyish brown (brownish black) (10YR 3/2)
Dry:	

FIELD CHEMICAL TESTS:

pH:	6 (Raupach)

STRUCTURE:

Grade of Pedality:	weak pedality	Fabric:	rough-faced peds
Dominant Peds:	2 - 5 mm,polyhedral		
Subdominant Peds:	< 2 mm,granular		
Artificial Aggregates:			

COARSE FRAGMENTS:

Type:	not evident	Amount:	none	Distribution:	Orientation:	Weathering:
Shape:						
Size:						
Type:	not evident	Amount:	none	Distribution:	Orientation:	Weathering:
Shape:						
Size:						

ROOTS:

<1 mm size:	few (1-10/10x10cm)	1-2 mm size:	none	2-5 mm size:	>5 mm size:

CONSISTENCE:

Degree of Plasticity:		Stickiness:	moderately sticky
Texture Modifier:	no change	Disruptive Test:	moderately weak force
Shearing Test:	crumbly	Toughness:	

SOIL WATER STATUS: moderately moist

ERODIBILITY TESTS:

Crumb Test:	no change	Bolus Formation:	Field Dilatency:

SOIL ERODIBILTY: low

SAMPLE TAKEN: disturbed

BOUNDARY:

Distinctiveness:	clear (20-50 mm)	Shape:	smooth

LAYER 3 B2 horizon
Depth: 00.45 - 00.90

TEXTURE: heavy clay

COLOUR:
Moist: dark grey (brownish grey) (10YR 4/1)
Dry:

FIELD CHEMICAL TESTS:
pH: 9 (Raupach)

STRUCTURE:

Grade of Pedality:	strong pedality	Fabric:	smooth-faced peds
Dominant Peds:	20 - 50 mm,sub-angular blocky		
Subdominant Peds:	10 - 20 mm		
Artificial Aggregates:			

COARSE FRAGMENTS:

Type:	not evident	Amount:	none	Distribution:	Orientation:	Weathering:
Shape:						
Size:						
Type:	not evident	Amount:	none	Distribution:	Orientation:	Weathering:
Shape:						
Size:						

ROOTS:

<1 mm size:	none	1-2 mm size:	none	2-5 mm size:	>5 mm size:

CONSISTENCE:

Degree of Plasticity:		Stickiness:	moderately sticky
Texture Modifier:	no change	Disruptive Test:	moderately strong force
Shearing Test:	plastic	Toughness:	

SOIL WATER STATUS: moderately moist

ERODIBILITY TESTS:

Crumb Test:	aggregates slake	Bolus Formation:	Field Dilatency:

SOIL ERODIBILTY: high

SAMPLE TAKEN: disturbed

LAYER NOTES: Very likely saline. Greyish, moist. Not mottled

BOUNDARY:
Distinctiveness: abrupt (5-20 mm) Shape: irregular

LAYER 99 horizon
Depth: -

LABORATORY TESTS:

Sample No:	151
Depth:	00.00 - 00.00 m
Test Results:	
N504.99 [Oven-dry moisture content]:	4.6
N518.99 [Volume expansion]:	18
N517.99_CL [PSA clay - SDS]:	26
N517.99_SI [PSA silt - SDS]:	35
N517.99_FS [PSA fine sand - SDS]:	34
N517.99_CS [PSA coarse sand - SDS]:	2
N517.99_GR [PSA gravel - SDS]:	3
N514.99 [Dispersion percentage]:	22
N513.98 [Emerson aggregate test SCS method]:	3(1)
N550.01 [USCS - lab]:	CL
N504.02_FC [Field Capacity, SWC pressure plate]:	38.6
N504.02_PWP [Permanent Wilt Point, SWC pressure plate]:	16.3
N515.99 [Wind erodible aggregate percentage]:	25
N505.99 [Water repellence field method]:	0
N3A1 [EC of 1:5 soil/water extract]:	0.11
N4A1 [pH of 1:5 soil/water suspension]:	6.7
N4B1 [pH of 1:5 soil/0.01M CaCl2 extract - direct, no stir]:	5.7
N15F1_CEC [CEC by 0.01M silver-thiourea (AgTU)+, no pret.]:	24.1
N15F1_CA [Exchangeable Ca - 0.01M (AgTU)+, no pretreatment]:	11.1
N15F1_MG [Exchangeable Mg - 0.01M (AgTU)+, no pretreatment]:	7.4
N15F1_NA [Exchangeable Na - 0.01M (AgTU)+, no pretreatment]:	0.5
N15F1_K [Exchangeable K - 0.01M (AgTU)+, no pretreatment]:	0.9
N15F1_AL [Exch. bases (Al+), 0.01M (AgTU)+, no pretreat.]:	0.0
N6A1 [Organic carbon - Walkley & Black]:	2.52
N9E1 [Fluoride-extractable P (Bray 1-P) - manual colour]:	2
N9I1 [Phosphate sorption index]:	265
Sample No:	152
Depth:	00.25 - 00.25 m
Test Results:	
N504.99 [Oven-dry moisture content]:	5.1
N518.99 [Volume expansion]:	8
N517.99_CL [PSA clay - SDS]:	29
N517.99_SI [PSA silt - SDS]:	35
N517.99_FS [PSA fine sand - SDS]:	19
N517.99_CS [PSA coarse sand - SDS]:	3
N517.99_GR [PSA gravel - SDS]:	14
N514.99 [Dispersion percentage]:	31

N513.98 [Emerson aggregate test SCS method]:	3(4)
N550.01 [USCS - lab]:	CL
N504.02_FC [Field Capacity, SWC pressure plate]:	37.8
N504.02_PWP [Permanent Wilt Point, SWC pressure plate]:	16.9
N515.99 [Wind erodible aggregate percentage]:	22
N505.99 [Water repellence field method]:	0
N3A1 [EC of 1:5 soil/water extract]:	0.33
N4A1 [pH of 1:5 soil/water suspension]:	7.4
N4B1 [pH of 1:5 soil/0.01M CaCl2 extract - direct, no stir]:	6.1
N15F1_CEC [CEC by 0.01M silver-thiourea (AgTU)+, no pret.]:	28.6
N15F1_CA [Exchangeable Ca - 0.01M (AgTU)+, no pretreatment]:	11.2
N15F1_MG [Exchangeable Mg - 0.01M (AgTU)+, no pretreatment]:	8.8
N15F1_NA [Exchangeable Na - 0.01M (AgTU)+, no pretreatment]:	2.7
N15F1_K [Exchangeable K - 0.01M (AgTU)+, no pretreatment]:	0.5
N15F1_AL [Exch. bases (Al+), 0.01M (AgTU)+, no pretreat.]:	0.0
N6A1 [Organic carbon - Walkley & Black]:	1.96
N9E1 [Fluoride-extractable P (Bray 1-P) - manual colour]:	2
N9I1 [Phosphate sorption index]:	367
Sample No:	153
Depth:	00.45 - 00.45 m
Test Results:	

N504.99 [Oven-dry moisture content]:	7.3
N518.99 [Volume expansion]:	fs
N518.01 [Linear shrinkage]:	19.0
N517.99_CL [PSA clay - SDS]:	48
N517.99_SI [PSA silt - SDS]:	26
N517.99_FS [PSA fine sand - SDS]:	3
N517.99_CS [PSA coarse sand - SDS]:	2
N517.99_GR [PSA gravel - SDS]:	21
N516.01_CL [Non-dispersed PSA clay]:	22
N516.01_SI [Non-dispersed PSA silt]:	41
N516.01_FS [Non-dispersed PSA fine sand]:	28
N516.01_CS [Non-dispersed PSA coarse sand]:	6
N516.01_GR [Non-dispersed PSA gravel]:	3
N514.99 [Dispersion percentage]:	89
N513.98 [Emerson aggregate test SCS method]:	2(1)
N550.01 [USCS - lab]:	CH
N504.02_FC [Field Capacity, SWC pressure plate]:	48.9
N504.02_PWP [Permanent Wilt Point, SWC pressure plate]:	22.2
N515.99 [Wind erodible aggregate percentage]:	0
N505.99 [Water repellence field method]:	1
N3A1 [EC of 1:5 soil/water extract]:	1.25
N4A1 [pH of 1:5 soil/water suspension]:	8.7
N4B1 [pH of 1:5 soil/0.01M CaCl2 extract - direct, no stir]:	7.5
N15F1_CEC [CEC by 0.01M silver-thiourea (AgTU)+, no pret.]:	42.3
N15F1_CA [Exchangeable Ca - 0.01M (AgTU)+, no pretreatment]:	7.0
N15F1_MG [Exchangeable Mg - 0.01M (AgTU)+, no pretreatment]:	13.5
N15F1_NA [Exchangeable Na - 0.01M (AgTU)+, no pretreatment]:	13.0
N15F1_K [Exchangeable K - 0.01M (AgTU)+, no pretreatment]:	0.6
N15F1_AL [Exch. bases (Al+), 0.01M (AgTU)+, no pretreat.]:	0.0
N6A1 [Organic carbon - Walkley & Black]:	0.83
N9E1 [Fluoride-extractable P (Bray 1-P) - manual colour]:	5
N9I1 [Phosphate sorption index]:	518

For information on laboratory test data and units of measure, please see the SPADE Help page

SALIS Soil Technical Report To contact us email:soils@dnr.nsw.gov.au Fri Oct 18 15:58:25 EST 2013

Appendix B
Climate Data

Phase 1 Contamination Assessment and Salinity Assessment
Part Lot 24 DP1086823, 10 Crase Place,
Grasmere, NSW

Figure B-1: Camden Airport Weather Station Relative to Site

Australian Government
Bureau of Meteorology

Climate statistics for Australian locations

Monthly climate statistics

All years of record

Site name: CAMDEN AIRPORT AWS **Site number:** 068192 **Commenced:** 1943
Latitude: 34.04° S **Longitude:** 150.69° E **Elevation:** 74 m **Operational status:** Open
Map

View: Main statistics All available Period: Use all years of data Text size: Normal Large

Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years	
Temperature															
Maximum temperature															
Mean maximum temperature (°C)	29.5	28.6	26.7	23.8	20.5	17.7	17.2	19.0	21.9	24.1	26.1	28.4	23.6	36	1971 2013
Highest temperature (°C)	46.4	43.2	41.0	38.5	27.5	24.9	25.4	30.2	36.0	40.5	42.6	43.1	46.4	36	1971 2013
Date	18 Jan 2013	21 Feb 1980	09 Mar 1983	04 Apr 1986	03 May 2007	01 Jun 1976	22 Jul 2009	30 Aug 1982	30 Sep 1980	21 Oct 1988	25 Nov 1982	17 Dec 2009	18 Jan 2013		
Lowest maximum temperature (°C)	17.9	17.0	17.0	16.6	12.0	10.8	9.6	11.2	13.4	13.2	14.0	16.0	9.6	36	1971 2013
Date	13 Jan 1972	07 Feb 1973	02 Mar 1987	29 Apr 2009	30 May 2000	12 Jun 1975	20 Jul 1983	22 Aug 2008	01 Sep 1987	16 Oct 1976	16 Nov 1988	10 Dec 2002	20 Jul 1983		
Decile 1 maximum temperature (°C)	23.5	22.5	22.0	19.8	17.2	15.0	14.5	15.8	17.2	18.5	20.0	22.2		38	1971 2013
Decile 9 maximum temperature(°C)	36.0	35.0	31.7	27.8	23.9	20.3	20.0	22.7	27.5	30.6	33.0	35.5		38	1971 2013
Mean number of days ≥ 30 °C	13.2	10.2	5.9	0.9	0.0	0.0	0.0	0.0	1.1	4.0	6.4	10.5	52.2	36	1971 2013
Mean number of days ≥ 35 °C	4.6	2.9	0.8	0.0	0.0	0.0	0.0	0.0	0.1	0.5	1.6	3.4	13.9	36	1971 2013
Mean number of days ≥ 40 °C	1.1	0.5	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.3	2.4	36	1971 2013
Minimum temperature															
Mean minimum temperature (°C)	16.8	16.8	14.8	11.0	7.0	4.5	3.0	3.8	6.7	9.9	12.9	15.1	10.2	36	1971 2013
Lowest temperature (°C)	7.9	7.2	5.9	-0.7	-2.2	-5.4	-6.0	-4.0	-1.8	1.3	3.8	5.7	-6.0	36	1971 2013
Date	02 Jan 1972	23 Feb 1993	31 Mar 2008	23 Apr 2006	29 May 1987	26 Jun 1986	12 Jul 2002	02 Aug 1986	01 Sep 2012	01 Oct 1982	19 Nov 1977	19 Dec 2005	12 Jul 2002		
Highest minimum temperature (°C)	23.5	24.0	22.0	19.4	17.5	15.0	14.5	15.0	16.3	18.6	21.7	24.0	24.0	36	1971 2013
Date	25 Jan 1982	03 Feb 2011	19 Mar 2000	10 Apr 1978	01 May 1973	08 Jun 1991	06 Jul 1988	17 Aug 1988	23 Sep 2003	29 Oct 1988	21 Nov 2009	23 Dec 2000	23 Dec 2000		
Decile 1 minimum temperature (°C)	13.0	13.0	10.6	6.2	2.0	-0.5	-1.3	-0.5	2.0	5.0	8.6	11.0		37	1971 2013
Decile 9 minimum temperature (°C)	20.0	20.0	18.3	15.3	12.3	9.9	8.0	9.0	11.5	14.2	17.0	18.7		37	1971 2013
Mean number of days ≤ 2 °C	0.0	0.0	0.0	0.2	3.4	10.1	14.2	11.6	3.4	0.2	0.0	0.0	43.1	36	1971 2013
Mean number of days ≤ 0 °C	0.0	0.0	0.0	0.0	0.9	4.5	7.7	4.4	0.5	0.0	0.0	0.0	18.0	36	1971 2013
Ground surface temperature															
Mean daily ground minimum temperature (°C)															
Lowest ground temperature (°C)															
Date															
Mean number of days ground min. temp. ≤ -1 °C															

Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years	
Rainfall															
Mean rainfall (mm)	77.9	101.6	87.7	66.9	57.6	61.6	37.9	41.4	39.5	65.3	77.0	54.9	767.2	39	1943 2013
Highest rainfall (mm)	263.6	421.8	343.6	338.2	309.3	304.4	143.1	276.4	148.2	242.8	167.2	162.7	1261.2	39	1943 2013
Date	1978	1990	1978	1988	1943	1991	1984	1986	1982	1987	2007	1991	1978		
Lowest rainfall (mm)	0.0	12.8	0.0	2.3	0.8	2.0	0.2	0.6	1.6	0.3	8.8	0.0	446.7	39	1943 2013
Date	1960	1944	1943	1980	2008	2001	1977	1982	1989	1988	1982	1974	1979		
Decile 1 rainfall (mm)	18.5	21.2	18.1	10.2	5.2	7.2	8.6	4.5	6.7	9.9	18.7	17.1	502.6	39	1943 2013
Decile 5 (median) rainfall (mm)	58.4	79.4	63.4	36.6	41.0	40.6	29.0	19.8	36.0	47.8	70.5	41.2	796.8	39	1943 2013
Decile 9 rainfall (mm)	147.8	255.7	173.4	143.1	128.1	160.2	73.2	103.5	72.3	155.6	149.1	96.2	1060.3	39	1943 2013
Highest daily rainfall (mm)	125.2	156.0	99.4	108.0	89.4	135.0	83.0	142.6	61.4	109.2	66.4	70.4	156.0	39	1943 2013
Date	29 Jan 2013	03 Feb 1990	20 Mar 1978	30 Apr 1988	01 May 1988	11 Jun 1991	06 Jul 1988	06 Aug 1986	21 Sep 1982	25 Oct 1987	03 Nov 2007	13 Dec 2008	03 Feb 1990		
Mean number of days of rain	10.2	10.9	10.3	9.2	8.7	8.7	8.1	7.6	7.9	10.0	10.6	9.2	111.4	39	1943 2013
Mean number of days of rain ≥ 1 mm	4.5	4.7	4.4	3.9	3.5	3.3	2.9	2.8	3.1	4.2	4.6	4.1	46.0	39	1943 2013
Mean number of days of rain ≥ 10 mm	1.4	1.7	1.6	1.1	1.1	1.1	0.6	0.5	0.7	1.1	1.4	1.1	13.4	39	1943 2013
Mean number of days of rain ≥ 25 mm	0.4	0.6	0.4	0.4	0.3	0.4	0.2	0.3	0.2	0.3	0.5	0.2	4.2	39	1943 2013

Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years	
Other daily elements															
Mean daily wind run (km)	185	168	144	137	128	139	157	177	195	177	187	187	165	10	2003 2013
Maximum wind gust speed (km/h)	91	102	109	68	74	80	87	93	109	83	102	76	109	10	2003 2013
Date	14 Jan 2005	14 Feb 2005	05 Mar 2007	03 Apr 2009	07 May 2006	19 Jun 2004	05 Jul 2007	01 Aug 2008	24 Sep 2006	06 Oct 2008	10 Nov 2003	17 Dec 2005	24 Sep 2006		
Mean daily sunshine (hours)															

Mean daily solar exposure (MJ/m^2)	22.4	19.1	16.8	13.9	10.5	8.7	9.8	13.3	17.1	20.3	21.5	23.2	16.4	24	1990 2013
Mean number of clear days	5.9	4.6	6.6	7.8	8.0	9.2	10.1	11.2	9.2	7.1	6.1	6.1	91.9	26	1943 2010
Mean number of cloudy days	10.8	10.2	9.6	8.8	8.9	7.2	6.4	5.0	6.5	9.1	9.5	8.6	100.6	26	1943 2010
Mean daily evaporation (mm)															

Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years	
9 am conditions															
Mean 9am temperature (°C)	21.6	20.9	19.6	16.9	13.0	9.6	8.6	10.7	14.6	17.7	18.7	20.9	16.1	37	1943 2010
Mean 9am w et-bulb temperature (°C)	18.5	18.4	17.1	14.6	11.5	8.3	7.1	8.6	11.4	13.8	15.4	17.2	13.5	33	1943 2010
Mean 9am dew -point temperature (°C)	16.1	16.7	15.3	12.5	9.5	6.4	5.1	5.6	7.8	10.0	12.5	14.2	11.0	36	1943 2010
Mean 9am relative humidity (%)	72	78	77	77	81	82	81	73	66	64	69	68	74	36	1943 2010
Mean 9am cloud cover (oktas)	5.0	4.8	4.5	4.1	4.1	3.7	3.4	3.1	3.7	4.3	4.5	4.5	4.1	26	1943 2010
Mean 9am w ind speed (km/h)	6.5	5.5	6.0	6.3	5.4	5.9	5.8	7.9	9.0	9.3	8.0	7.9	7.0	35	1943 2010

Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years	
3 pm conditions															
Mean 3pm temperature (°C)	27.7	26.9	25.4	22.5	19.3	16.5	16.0	17.7	20.3	22.4	24.3	26.8	22.2	37	1943 2010
Mean 3pm w et-bulb temperature (°C)	20.0	19.8	18.8	16.3	14.0	11.6	10.8	11.4	13.4	15.5	17.5	18.7	15.6	33	1943 2010
Mean 3pm dew -point temperature (°C)	14.7	15.1	13.8	11.0	8.5	6.2	4.7	4.0	6.2	8.8	11.6	12.5	9.8	36	1943 2010
Mean 3pm relative humidity (%)	49	52	52	52	52	53	50	43	44	47	50	46	49	36	1943 2010
Mean 3pm cloud cover (oktas)	4.7	5.1	4.9	4.6	4.5	4.4	4.2	3.7	4.2	4.7	4.9	4.7	4.6	26	1943 2010
Mean 3pm w ind speed (km/h)	17.2	15.5	15.0	13.8	12.5	13.9	14.6	16.8	18.1	17.7	17.7	18.5	15.9	33	1943 2010

red = highest value blue = lowest value

Product IDCJCM0037 Prepared at Thu 31 Oct 2013 01:00:41 AM EST

Monthly statistics are only included if there are more than 10 years of data. The number of years (provided in the 2nd last column of the table) may differ between elements if the observing program at the site changed. More detailed data for individual sites can be obtained by contacting the Bureau.

Related Links

- This page URL: http://www.bom.gov.au/climate/averages/tables/cw_068192_All.shtml
- Summary statistics and locational map for this site: http://www.bom.gov.au/climate/averages/tables/cw_068192.shtml
- About climate averages: http://www.bom.gov.au/climate/cdo/about/about-stats.shtml
- Data file (csv): http://www.bom.gov.au/clim_data/cdio/tables/text/IDCJCM0037_068192.csv
- Climate averages home page URL: http://www.bom.gov.au/climate/data/index.shtml
- Bureau of Meteorology website: http://www.bom.gov.au

Page created: Thu 31 Oct 2013 01:00:41 AM EST

This page was created at **on**

Appendix C
Aerial Photograph Review

Phase 1 Contamination Assessment and Salinity Assessment
Part Lot 24 DP1086823, 10 Crase Place,
Grasmere, NSW

C AERIAL PHOTOGRAPH REVIEW

Selected aerial photographs dating back to 1954 were reviewed by Coffey for preparation of this report. Table C-1 summarises the main relevant observations made during the review.

Table C-1: Aerial Photograph Review

DATE	OBSERVATIONS
16/11/1954 (black & white)	**On Site:** Vacant grazing land. No trees evident. **Off Site:** Vacant grazing land. Remnant bushland north of Werombi Road. A structure is evident in the northeastern corner of Lot 24, close to the intersection of Werombi Road and The Old Oaks Road. The structure appears to be accessible from The Old Oaks Road, where a faint access leads from this road to the structure. Two dams are located adjacent to the southern and western site boundaries where a watercourse appears to flow between the dams. The watercourse continues north of the second dam towards Werombi Road.
7/10/1965 (black & white)	**On Site:** Site features are generally similar to those observed 1954, except for some minor ground disturbance. A line of disturbed ground extending from the southern boundary towards watercourse adjacent the site's western boundary. **Off Site:** The structure previously observed in the northeastern corner of Lot 24 is no longer evident. A second dam has been constructed northwest of the site, between the existing one west of the site and Werombi Road. Apart from water level changes in existing dams and some minor development (residential dwellings), the remaining areas have remained relatively unchanged since 1954.
30/11/1975 (black & white)	**On Site:** Unchanged since previous aerial photograph. **Off Site:** A third dam has been constructed northwest of the site, between the dam constructed in 1965 and Werombi Road. This dam is approximately one third the size of the other dams. The sewerage treatment plant is evident on Sheathers Lane, northeast of the Site. A residential dwelling and two large warehouse type structures are evident southeast of the site. Remaining areas appear relatively unchanged.
8/10/1984 (Colour)	**On Site:** Some very small objects dispersed throughout the Site (and remaining parts of Lot 24). These objects could be livestock. Trees and shrubs are evident along parts of the southern and eastern site boundaries. Remaining areas appear unchanged. **Off Site:** Some of the dams have bright green colouration forming along dam edges suggesting algal bloom. Apart from changes in vegetation remaining areas appear unchanged.

DATE	OBSERVATIONS
4/1/1994 (Colour)	**On Site:** A very small object is evident in the southeastern portion of the site. Remaining areas appear unchanged. **Off Site:** The green colouration previously observed in dams is no longer apparent. Apart from minor changes, the general surrounding areas appear similar to the previous photograph.
21/7/2002 (Colour) Google Earth Image	**On Site:** The site continues to remain undeveloped. The very small objective observed in 1994 is no longer evident. The grass appears brown suggesting a period of low rainfall. **Off Site**: The general area is still predominantly vacant grazing land however the area continues to develop slowly with new residential dwellings appearing.
11/3/2007 (Colour) Google Earth Image	**On Site:** A cul-de-sac extending from the southern boundary into the site has been constructed (Crase Place). An access track extends north from the cul-de-sac through the site where it appears to terminate, offsite, at a circular area which appears to be a slight depression or higher moisture content. A second feature extending from the cul-de-sac appears to be a storm water drain that directs water west from the road towards the watercourse. Three small objects positioned along the length of this drain are also evident. This corresponds to a drainage easement marked on title diagrams. **Off Site**: Exposed ground is evident is areas north of the site. Near these areas are either slight depressions or high moisture content (as previously discussed). These areas are located adjacent to the dams. White efflorescence was observed in areas immediately surrounding dams located west of the site. This white feature may also be associated with hydromulching as vegetation growth substantially increases in later years. The third dam located northwest of the site and adjacent to Werombi Road is no longer evident. A network of roads servicing a new subdivision is evident in areas south and west of the site. The realignment of The Old Oaks Road appears under construction.
2/11/2012 (Colour) Google Earth Image	**On Site:** Except for the cul-de-sac, the site continues to remain undeveloped. The remaining features observed in the previous aerial photograph have faded. Sporadic growth of trees and/or shrubs is evident throughout and north of the site. **Off Site**: The exposed ground and access track extending north of the cul-de-sac are no longer evident. Extensive growth of tree and/or shrubs is evident in along the watercourse and areas surrounding the dams located west and north of the site. Residential developments continue in areas surrounding the site. The former alignment of The Old Oaks Road has been blocked with a fill mound at the intersection with Werombi Road. The realignment of The Old Oaks Road appears complete.

AERIAL PHOTOGRAPH 1954

AERIAL PHOTOGRAPH 1965

revision	description	drawn	approved	date

drawn	LZ
approved	SR
date	1.10.13
scale	1:2000
original size	**A3**

coffey

client: SITE PLUS

project: PHASE 1 CONTAMINATION ASSESSMENT & SALINITY ASSESSMENT PART LOT 24 DP1086823, 10 CRASE PLACE, GRASMERE, NSW

title: AERIAL PHOTOGRAPHS - 1954 AND 1965

project no: ENAUWOLL04150AA-R01

figure no: C-1

AERIAL PHOTOGRAPHY 1974

AERIAL PHOTOGRAPHY 1984

revision	description	drawn	approved	date

drawn	LZ
approved	SR
date	1.10.13
scale	1:1250
original size	A3

coffey

client: SITE PLUS

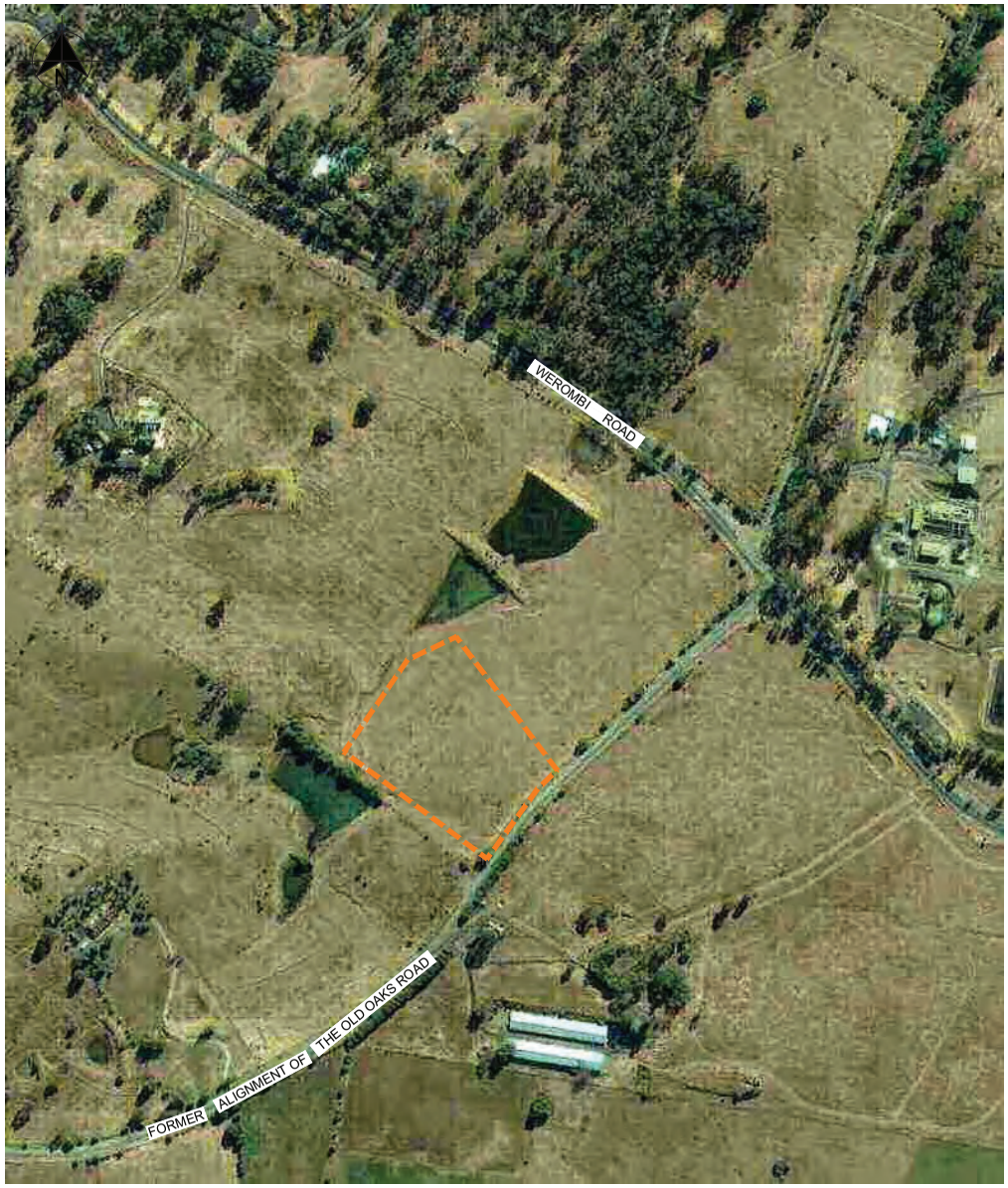
project: PHASE 1 CONTAMINATION ASSESSMENT & SALINITY ASSESSMENT
LOT 24 DP1086823, CRASE PLACE, GRASMERE, NSW

title: AERIAL PHOTOGRAPHS - 1974 AND 1984

project no: ENAUWOLL04150AA-R01

figure no: C-2

AERIAL PHOTOGRAPH 1994



AERIAL PHOTOGRAPH 2002

AERIAL IMAGE SOURCE: GOOGLE EARTH PRO 6.0.1

AERIAL IMAGE ©: SINCLAIR KNIGHT MERZ 2013

revision	description	drawn	approved	date

drawn	LZ
approved	SR
date	1.10.13
scale	1:2222
original size	**A3**

coffey

client: SITE PLUS

project: PHASE 1 CONTAMINATION ASSESSMENT & SALINITY ASSESSMENT PART LOT 24 DP1086823, 10 CRASE PLACE, GRASMERE, NSW

title: AERIAL PHOTOGRAPHS - 1994 AND 2002

project no: ENAUWOLL04150AA-R01

figure no: C-3

AERIAL PHOTOGRAPH 2007

AERIAL IMAGE SOURCE: GOOGLE EARTH PRO 6.0.1
AERIAL IMAGE ©: SINCLAIR KNIGHT MERZ 2013

AERIAL PHOTOGRAPH 2012

AERIAL IMAGE SOURCE: GOOGLE EARTH PRO 6.0.1
AERIAL IMAGE ©: SINCLAIR KNIGHT MERZ 2013

revision	description	drawn	approved	date

drawn	LZ
approved	SR
date	1.10.13
scale	1:5000
original size	**A3**

coffey

client: SITE PLUS

project: PHASE 1 CONTAMINATION ASSESSMENT & SALINITY ASSESSMENT PART LOT 24 DP1086823, 10 CRASE PLACE, GRASMERE, NSW

title: AERIAL PHOTOGRAPH - 2007 AND 2012

project no: ENAUWOLL04150AA-R01

figure no: C-4

Appendix D
Section 149 Planning Certificate and Development Applications

Phase 1 Contamination Assessment and Salinity Assessment
Part Lot 24 DP1086823, 10 Crase Place,
Grasmere, NSW